Faculty of Mathematics and Natural Science
Yogyakarta State University

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Proceedings

“ The Global challenges on the development
and the education of mathematics and science “

3rd ICRIEMS

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The Global Challenges on The Development and
The Education of Mathematics and Science

Faculty of Mathematics and Science
Yogyakarta State University

3rd ICRIEMS : The Global Challenges on The Development and The Education of Mathematics and Science

- Mathematics & Mathematics Education
- Physics & Physics Education
- Chemistry & Chemistry Education
- Biology & Biology Education
- Science Education

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Preface

Bless upon God Almighty such that this proceeding on 3rd International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) may be compiled according to the schedule provided by the organizing committee. All of the articles in this proceeding are obtained by selection process by the reviewer team and have already been presented in the Conference on 16 – 17 May 2016 in the Faculty of Mathematics and Natural Sciences, Yogyakarta State University. This proceeding comprises 9 fields, that is mathematics, mathematics education, physics, physics education, chemistry, chemistry education, biology, biology education, and science education.

The theme of this 3rd ICRIEMS is '*The Global Challenges on The Development and The Education of Mathematics and Science*'. The main articles in this conference are given by six keynote speakers, which are Prof. Allen Price, Ph.D (Emmanuel College Boston USA), Ana R. Otero, Ph.D (Emmanuel College Boston USA), Dr. Michiel Doorman (Utrecht University, Netherlands), Prof. Dr. Marsigit, M.A (Yogyakarta State University), Asst. Prof. Dr. Warakorn Limbut (Prince of Songkla University, Thailand), and Prof. Dr. Rosly Jaafar (Universiti Pendidikan Sutan Idris, Malaysia). Besides the keynote and invited speakers, there are also parallel articles that presented the latest research results in the field of mathematics and sciences, and the education. These parallel session speakers come from researchers from Indonesia and abroad.

Hopefully, this proceeding may contribute in disseminating research results and studies in the field of Mathematics and Sciences and the Education such that they are accessible by many people and useful for the Nation Building.

Yogyakarta, May 2016

The Editor Team

Forewords From The Head Of Committee

Assalamu'alaikum warahmatullahi wabarakatuh

May peace and God's blessings be upon us all

First of all, allow me to thanks to God, Allah SWT, who has been giving us blessing and mercies so we can join this conference. Ladies and Gentlemen, it is my great honor to welcome you to Indonesia, a unique country which has more than 17,000 islands, more than 1,300 ethnic groups, and more than 700 local languages, and I am also very happy to welcome you to Yogyakarta, the city of education, culture, tourism, and a miniature of Indonesia. We wish you be happy and comfortable in attending the conference in this city.

The third International Conference on Research, Implementation, and Education of Mathematics and Science (ICRIEMS 3rd) 2016 is organized by the Faculty of Mathematics and Science, State University of Yogyakarta. In this year, theme of the conference is : The Global Challenges on The Development and The Education of Mathematics and Science. This conference are dedicated to the 52nd anniversary of Yogyakarta State University and to face challenges of Asean Economic Community in 2016.

This conference facilitates academics, researchers and educators to publish and disseminate their research in the fields of pure, application and education of Science and Mathematics. Furthermore, the purposes of the conference are to establish interaction, communication, and cooperation among academics, researchers and educators at an international level.

On behalf of the committee of this conference, I would like to express our highest appreciation and gratitude to the keynote speakers, including:

1. Allen Price, Ph.D. (Associate Professor of Emmanuel College, Boston USA)
2. Ana R. Otero, Ph.D. (Emmanuel College, Boston USA)
3. Dr. L.M. (Michiel) Doorman (Associate Professor of Utrecht University, Netherland)
4. Prof. Dr. Marsigit, MA. (FMIPA, Universitas Negeri Yogyakarta)
5. Asst. Prof. Dr. Warakorn Limbut (Faculty of Science, Prince of Songkla University, Thailand)
6. Prof. Dr. Rosly Jaafar (Faculty of Physics, Universiti Pendidikan Sultan Idris, Malaysia)

Furthermore, we inform you that the papers presented in this conference are about 200 papers from 302 applicants, who come from various countries and various provinces throughout Indonesia. Therefore, I would like to give my appreciation and many thanks to the presenters and participants who have been actively involved in this seminar.

Finally, I would like to thank the committee members who have been working very hard since half a year ago to ensure the success of the conference. However, if you find any shortcomings and inconveniences in this conference, please forgive us. We would very happy to receive your suggestions for improvement in the next conference. Thank you very much.

Wassalamu'alaikum warohmatullahi wabarakatuh.

Yogyakarta, May 2016

Dr. Warsono, M.Si.

Forewords From The Dean Of Faculty Of Mathematics And Sciences, Yogyakarta State University

Assalamu'alaikum warahmatullahi wabarakatuh. My greetings for all of you. May peace and God's blessings be upon us all.

On behalf of the Organizing Committee, first of all allow me to extend my warmest greeting and welcome to the International Conference on Research, Implementation, and Education of Mathematics and Sciences, the third to be held by the Faculty of Mathematics and Science, State University of Yogyakarta, one of the excellent and qualified education universities in Indonesia. This conference is also celebrate the 52th Anniversary of State University of Yogyakarta.

This conference proudly presents keynote speeches by six excellent academics, these are: Allen Price, Ph.D., Ana R. Otero, Ph.D., Dr. Michiel Doorman, Prof. Dr. Marsigit, MA., Asst. Prof. Dr. Warakorn Limbut, and Prof. Dr. Rosly Jaafar, and around 200 regular speakers.

The advancement of a nation will be achieved if education becomes a priority and firmly supported by the development of technology. Furthermore, the development of technology could be obtained if it is supported by the improvement of basic knowledge such as mathematics, physics, chemistry, and biology. The empowerment of this fundamental knowledge may be achieved by conducting research which is then implemented in developing the technology and the learning process in schools and universities.

This international conference is aimed to gather researchers, educators, policy makers, and practitioners to share their critical thinking and research outcomes. Moreover, through this conference it is expected that we keep updated with new knowledge upon recent innovative issues and findings on the development and the education of mathematics and science, which is in accord with the theme of the conference this year. All material of the conference which are compiled in the abstract book and proceedings can be useful for our reference in the near future.

This conference will be far from success and could not be accomplished without the support from various parties. So let me extend my deepest gratitude and highest appreciation to all committee members who have done an excellent job in organizing this conference. I would also like to thank each of the participants for attending our conference and bringing with you your expertise to our gathering. Should you find any inconveniences and shortcomings, please accept our sincere apologies.

To conclude, let me wish you fruitful discussion and a very pleasant stay in Yogyakarta.

Wa'alaikumsalam warahmatullahi wabarakatuh

Yogyakarta, May 2016
Dean Faculty of Mathematics and Science
Yogyakarta State University

Dr. Hartono, M.Si.

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Lesson Study Among the Move of Educational Reformation in Indonesia

Marsigit
Department of Mathematics Education, Faculty of Mathematics and Science,
Yogyakarta State University

Abstract-Since the year of 2000, Government of Indonesia (GOI) and JICA-Japan has been experienced initiating, developing and implementing lesson studies activities to improve teaching learning quality in primary schools, secondary schools, and in universities; it covers the teaching learning of mathematics, natural sciences, social sciences, and languages. The Lesson Study activities was proven to be effective in lifting students' enthusiasm in learning science, helping students to develop their experimental and discussion skill, and in giving opportunities to students in developing their own scientific concept by themselves. It was also noted that by using constructivism approach, the students may find out their best style of learning. Competition rises among groups of students in presenting the results of their work and in defending their presentations. This forces students to learn more theory more for their own sake. As a result of Lesson Study activities there were many teaching material developed either by lecturers or by teachers. Through lesson study activities lecturers and/or teachers developed the teaching materials after thinking extensively what and how to develop teaching materials for a certain topic, and then develop the materials. In sum, at the schools and implementation level, lesson study was the succes story of teachers' professional development in Indonesia. However, it seems it has its struggle to employ those success come into the higher level of teachers; professional development i.e. the government policies of educational development. Whilest, the ministry of education strives to implement the new curriculum for primary and secondary schools and also for universities, the lesson studies activities looks like the beautiful girls who loose its accountability and its narations. The challenge is to what extent that the lesson study is to be able to contribute its role to support government effort to improve the quality of teaching at all levels.

Keywords: lesson study, quality of teaching, teachers' professional development

I. INTRODUCTION

Nowadays, lesson study has become a worldwide movement to improve teacher's professional development. It rooted from the the old Japanesse educational practice i.e. in the Meiji period of Japan, in which the teachers were willing to develop and reflect their own teaching in collaboration with other teachers. Since the 1960s, lesson study has been developed rapidly in Japan as a school-based in-service training of the candidates of teachers. Following the world conferences and seminars of lesson studies e.g. supported by JICA, APEC, Walls, CRICED, and CRME, lesson study then spread out around the world. Some countries has developed lesson studies as the bases for improving the quality of teaching and teachers' professional development. United Kingdom, China, USA, Australia, Thailand Singapore, Russia, Eastern Europe contries, some Africa's, South East Asian countries including Indonesia has experiences conducting lesson studies with their educational contexts.

International Cooperation on Lesson Study was started with the meeting of the third APEC Education Ministerial held on 29-30 April 2004 in Santiago. The meeting suggested to conduct a collaborative study on innovations for teaching and learning mathematics in different cultures among the APEC Member Economies. The recommended project then was managed by the Center for Research in Mathematics Education (CRME) of Thailand and the Center for Research on International Cooperation in Educational Development (CRICED) of Japan. Some theme were chosen: Mathematical Thinking, Communication, Evaluation and Generalization. The purpose of project were to collaboratively share the ideas and ways of mathematical thinking which is necessary for science, technology, economical life and development on the APEC member economies, and collaboratively develop the teaching approaches on mathematical thinking through Lesson Study among the APEC member economies. In the document of "APEC – Tsukuba International Conference on Innovative Teaching Mathematics through Lesson Study

(II)- Focusing on Mathematical Thinking –“ it was organized to support specialist Lesson Study from Chile, China, Indonesia, Malaysia, Mexico, Papua New Guinea, Peru, Philippines, Russia, Thailand, and Vietnam.

All sides aggre that one of the role of lesson study activities is to shift the old paradigm to the new ones.

Table 1: The Paradigmatic Changes Promoted by lesson study

Old Paradigm	**Recommended Pradigm**
Education as investment	Education as a need
Learning as an obligation	Learning as a need
Short-term orientation	Long-term orientation
Competiton	Cooperation
Instrumental curriculum	Interactive curriulum
Teachers as curriculum implementers	Teachers as curriculum developers
Dominant teachers/teacher-centred	Students’ initiations/student centred
Very structured curriculum	Flexible curriculum
Product oriented	Process and product oriented
Uniformity	Diversity
Single method (lecturing)	Various methods (lecturing, discussion, ecperiment, investigation, practical work)
Transfer of knowledge	Constructivist
Stressing on theories	Theories and practice
Cognition	Affective, cognition and skills
Text-book oriented	Life oriented
Objective test	Authentic assessment/portfolio
Exit national exam as an end	Exit national exam as a tool for improving the qualotu of education

Mixing from values beliefs and empirical evidences, there are currently demands in Indonesia, that any educational reform should handle the issues of: (a) how to promote interactive curriculum rather than instrumental curriculum?, (b) how to promote student centered approach rather than teacher centered approach?, (c) how to promote students’ initiation rather than teacher’s domination?, and (d) how to promote simple and flexible curriculum rather than crowded and tight-structured curriculum? While in term of observable good practice, there were demands that teachers need to have a chance to reflect their teaching in such away that they may move from older paradigm of teaching to the new one. Teachers may move from emphasizing the “teaching” to emphasizing the “learning”; they may move from the act of “transferring teacher’s knowledge” to “constructing students’ knowledge”.

The Decree of Sisdiknas No. 20 year 2003, Indonesian Educational System should develop intelligence and skills of individuals, promoting good conduct, patriotism, and social responsibility, fostering positive attitudes of self reliance and development. Improving the quality of teaching is one of the most important tasks in raising the standard of education in Indonesia. The programs which have been carried out to improve the quality of teaching are the improvement the quality of teachers; the provision of learning facilities and equipment; the improvement of the curricula for basic education; and, the development and utilization of communication technology for education, in support of the teaching learning process. The improvement of the quality of teaching, thus, has been one of the fundamental issues in the improvement of the quality of education in Indonesia. The quality of teaching learning process is closely related with what the students do in the classroom.

The School-Based Primary mathematics curriculum outlines that the aims of teaching learning of mathematics are as follows: to understand the concepts of mathematics, to explain the relationships among them and to apply them to solve the problems accurately and efficiently; to develop thinking skills to learn patterns and characteristics of mathematics, to manipulate them in order to generalize, to proof and to explain ideas and mathematics propositions; to develop problems solving skills which covers understanding the problems, outlining mathmatical models, solving them and estimating the outcomes; to communicate mathematics ideas using symbols, tables, diagrams and other media; to develop appreciations of the uses of mathematics in daily lifes, curiosity, consideration, and willingness to learn mathematics as well as tough and self-confidence.

Since the 2014s, the Ministry of Education has implemented the new centralized curriculum, called Curriculum 2013. From its start, it seems that the implementation of the new curriculum faces the huge gap between the ideals and the practicality. By introducing the new curriculum, government wish to inprove the quality of education. The curriculum consists of many concept of changes and revisison of the previous curriculum. Scientific method was introduced as the only single approach for teaching at all level and for all subjects. Through the new curriculum, the government let the teachers to employ the methods which is conform with the scientific approach, e.g problem-based method, project-based method, discovery method, and cooperative method. For the younger learner i.e primary schools, the government was also intruduced integratif and thematic approach.

However, there are significans finding that the implementation of Curriculum 2013 has many fundamental problems related to teachers'competencies and class, school management and leaving examination system. The teachers has its culture with conventional teaching, and it is not easy to change the teachers' mindset of teaching. The problems also emerge from how to manage teachers' competencies and teachers backgrounds in order to match with the structure of curriculum; some big changes heppened from this matter due they are also related with the teachers'certification. Some teachers perceive and argue about the relevant and significant of the final examination; they think that national examination system does not really concord with the methods of teaching and students activities to be promoted.

From the stated curriculum, it can be learned that teaching learning mathematics involves the teaching of many different areas of knowledge, and of many skills. When new knowledge or skills are required for problem solving, the students need to develop their mathematical attitude. Katagiri, S. (2004) suggests that, to develop mathematical attitude, students need to realize which previously learned, to "sense the necessity of" and "perceive the need or desirability of using" new knowledge and skills. It concludes that it is important to conduct classroom-based research to investigate the necessary driving factors towards the required knowledge and skills. It is also important to make sure that students first understand the benefits of using knowledge and skills when they possess and utilize such a drive. This leads them to fully acquire the knowledge and skills they have used. Cultivating the power of students to think independently and to perform mathematical attitude and mathematical thinking will be the most important finding in this research.

In Indonesia the Lesson Studies were developed in which the teachers, in collaboration with Lecturers and Japanese Experts, tried out some teaching models at schools. The Lecturers of Teacher Training Program and School Teachers worked collaboratively, composes some numbers of Lesson Studies. The grounds of the Lesson Study activities were reflecting and promoting the new paradigm of the secondary mathematics and science education, in which learning activities are not only perceived pragmatically and short-time oriented but also to be perceived as a long-life time purposes. Lesson Study activities let the teachers to reflect and evaluate, in cooperation with lectures or other teachers, their paradigm of teaching. Approaches of Lesson Studies covered (a) students cooperation with others in their learning, (b) contextual teaching and learning, (c) life-skill, (d) hands-on activities, (e) interactive process oriented curriculum and syllabi development, and (f) teachers and students autonomous. From those three sites of study, there can be produced the notions of educational improvement, in term of teacher, student and lecture.

In general, the implementation of lesson study indicated improvements of (a) teachers' competencies (creativity, questioning skills, experiemental methods), and (b) teaching and learning processes, and (c) students' activities, motivation, enthusiasm and performances.Besides, the project also resulted in the developments of CAIs for Chemistry, authentic assessment methods, student worksheets, and constructivist approach. However, the evaluation also identified that: (1) teachers have varied in their perceptions of the new paradigm of mathematics and science education; (2) the new approaches take much more time than conventional ones; (3) Enculturing innovation needs time; (4) the existing curriculum is found to be too crowded; (5) the existing class is still too big for the new approaches; (6) most teaching and learning processes were still oriented to the exit national exam; and (7) teachers were resistent to changes. However, its contribution to the accountability and sustainability of educational development is still a crutial issue.

II. LESSON STUDY SUPPORTS EDUCATIONAL REFORM

Under cooperation between Government of Indonesia (GOI) and JICA-Japan, three universities UPI Bandung, UNY Yogyakarta and UM Malang carried out project called IMSTEP-JICA for pursuing good practice of mathematics (and sciences) teaching by empowering and developing teacher education. Starting in 1999 and lasting in 2005, the extending of the project resulting piloting activities through Lesson Studies for good practice of secondary mathematics teaching in three cluster site West Java, Central Java and East Java. Results of the studies significantly indicated that there are improvements of the practice of secondary mathematics teaching learning processes in term of teaching methodology, teacher competencies, students achievements, alternative evaluation, teaching learning resources and syllabus. However, some misconceptions of counterpart made Lesson Study through IMSTEP was not effective yet. The following Lesson Study activities were conducted under the schema of SISTTEM, stand for Strengthening In-Service Teacher Training of Mathematics and Science Education at Junior Secondary Level, was born from the cooperation between JICA (Japan International Cooperation Agency) and MONE / Depdiknas (Ministry of National Education / Departemen Pendidikan Nasional) of Indonesia. The Overall Goal of SISTTEM is to develop the model of in-service teacher training primarily through MGMP activities applying lesson study; to continue teacher professional development in the target province; and to improve the level of student learning ability in mathematics and science in the target districts. At the national level, the *Lesson study* project can be a statewide movement for professional development of primary and secondary education. Through IMSTEP and SISTTEM, since 2001, DGMPSE (Directorate General of Management of Primary and Secondary Education, in cooperation with JICA-Japan, has initiated Lesson Study as a model of professional development designed to assist teachers produce quality lesson plans and gain a better understanding of student learning in primary and secondary mathematics and science.

A. Lesson Study is the Way to Reform Teaching Practice

Previous study by IMSTEP indicated that to encourage mathematics teachers' professional development, all sides in educational system should consider the promotion of: (1) good atmosphere for teaching and learning, (2) various teaching methods and teaching learning resources, (3) chances for the teachers and their students to perform their initiatives, (4) cooperative learning, (5) research class as a model for educational innovations (as Japanese teachers do), (6) teachers' role to develop their curriculum, (7) school and teacher autonomy (8) school-based management, and (9) contextual teaching. Since the early of 2000, there are cooperations among universities, teacher training institutes and MoNE's Directorate of Secondary Education to improve teachers' competencies to support the implementation of the proposed competent-based curriculum (Curriculum 2004).

Government agenda for implementing the new curriculum lead to the need for socialization the philosophy and the concepts of school-based curriculum as well as the results of lesson Study activities. Such socializations and workshops in which results of Lesson Study had been socialized. In the fiscal year 2001-2003, a medium scale of piloting of Teaching Learning Model of secondary mathematics and sciences through Lesson Study has been carried out by IMSTEP-JICA in collaboration with UPI Bandung, UNY Yogyakarta, and UM Malang, in which Japan Government supported facilities, training as well as Educational Experts.The objectives of the Lesson Study activities were to contribute the improvement of secondary mathematics education by pursuing good practice of mathematics teaching. Lesson Studies for secondary mathematics were carried out by mainly Classroom Action Research approach. Teachers carried out to improve the teaching learning practices and to find more appropriate methods for facilitating students learning. Teachers' experiences have been shared with other teachers and the lectures. The specific objectives of Lesson Study activities are: (1) to develop instrument and equipment for teaching learning process, (2) to develop teaching method and model for teaching learning process, (3) to develop teaching material for teaching learning process, and (4) to develop teaching evaluation for teaching learning process.

The results of Lesson Study could be inferred from the view of students, teachers, and of lecturers. Evidences were collected through observations, questionnaires and interviews. Teachers perceived that Lesson Study gave positive results because it could improve teachers' professionalism in finding variations of teaching approaches, and teaching methods. It introduced the new model of teaching in which teachers were able to increase the variation of alternatives on how to conduct classroom teaching and learning process. There were evidences that Lesson Study improved teachers' skill to communicate, to deliver questions, to carryout discussion as well as teachers' creativity. Teachers perceived that Lesson Study activities were useful to support the implementation of competence-based curriculum. Research conducted by SISTTEM found that Lesson Study through IMSTEP have two fundamental limitations i.e. problems observed in the follow up period and, challenges newly emerging in the forthcoming program. In the first place, one of the observed tasks throughout the follow up period is how to deepen the quality of LS. Observing and understanding realities and facts of students' learning and reflecting lessons based on such evidences are really difficult to conduct. The viewpoints of counterparts of IMSTEP tended to address only "how teachers teach" and fail to scrutinize "how students learn". The limitations in observers' viewpoints and positions are likely to limit the directions of discussion in teaching, rather than learning of students. Moreover, reflection tends to finish with criticism against the teachers who have opened their lesson for observation, not fostering learning from the observed practices. However, if teachers cannot develop learning relationship among themselves, LS will become a place for teachers only to "bash" each other for their faulty practices.

Under the schema of SISTTEM, Lesson Study were carried out in three different sites i.e. in Kabupaten Sumedang (West Java), Kabupaten Pasuruan (East Java), and Kabupaten Bantul (DI Yogyakarta); they jointly carried out by the Indonesian counterpart team and the JICA Expert Team in cooperation with the three universities, i.e. UPI, UNY and UM, which were the counterparts of the IMSTEP. In this schema, Lesson study is defined as a practice-oriented method for improving teaching skills by teachers themselves; in which, it usually includes: developing lesson plans (planning), practicing the lesson plans in real classes while peer teachers observe the lessons (open lesson), and reflecting on the lessons together to give feedback to the teachers (reflection). To implement Lesson Study, SISTTEM employs the results of previous schema i.e. IMSTEP especially in term of human resources. SISTTEM carries out some trainings for schools principals, leader of MGMP (teachers club), and supervisors. The content of training covers the concept of learning community, lessons study, and lessons innovation. The implementation of Lesson Study at entire school level is scheduled for two and a half years i.e. May 2006 -October 2008.

B. Lesson Study is to Reform Mathematics Teaching

In the first research of lesson study (Marsigit, 2007) the aim was to picture of mathematical thinking that is students thinking on the concept of Lowest Common Multiple (LCM) at the 4th Grade Students of Primary School in Indonesia. With the ground of the New School-Based Curriculum we, in collaboration with teacher, prepared teaching learning of LCM with Realistic Approach. The search in this lesson study strived to uncover the idea of mathematics as a human activity that is stressed in realistics approach. Teacher organized the class as a process of *guided reinvention* (De Lange, 1996, in Zulkardi, 2006) that is to step in learning LCM by developing instructional environment e.g. let the students to freely chose and develop their methods and aids to solve the problems. The teacher let the students to work individually and in group less formally to perform horizontal mathematization; and then anticipating the structure to more formal raise mathematization activities.

From the analyses of videotaped lesson, it was indicated that the students strived to develop horizontal mathematization through some activities. The students strived to represent daily problems in a related mathematical formula and strived to prove regularities of consisting concepts. Some students performed vertical mathematization by employing different models and formulated mathematical model to solve the problems. The striking results of the study illustrated that : 1) Students' thinkings of the concept of LCM were much contributed by teacher's employing real-life contexts as a starting point for their learning; 2) Students' thinking of the concept of LCM simultaneously affected by the use of their own productions of formulas and strategies; 3) In thinking the concept of LCM, interactions between teacher and students, students and students are the essential activities; and 4) Students' thinkings of the concepts of LCM were influenced by the connection among the strands of mathematical concepts developed previously e.g. the concept of factor of numbers and by the connection with meaningful problems in the real world.

The second research of lesson study (Marsigit, 2008), the aim is to reflect the promottion of students to develop mathematical method in learning the total area of a right circular cylinder and sphere, and the volume of a right circular cone. Specifically, the expected results of the research is to describe students' attempts or efforts in Katagiri S. (2004): inductive thinking, analogical thinking, deductive thinking, integrative thinking (including expansive thinking), developmental thinking, abstract thinking (thinking that abstracts, concretizes, idealizes, and thinking that clarifies conditions), thinking that simplifies, thinking that generalizes, thinking that specializes, thinking that symbolize, thinking that express with numbers, quantifies, and figures. At small group discussion Students learned that the lateral area of right circular cylinder is equal to the area of its rectangle i.e. mathematical thinking of analogy of concept and induction). Students learned that the total area of right circular cylinder is equal to the area of its rectangle plus the area of its two circles i.e. mathematical thinking of analogy of concept and induction.

In developing teaching learning methods, the teachers need to: plan the scenario of teaching, plan students activities, plan teachers' roles, distribute the assignments, develop assesment methods, and monitor the progress of students achievements. To develop their experiences, the teachers also need to participate frequently in such kinds of workshops or seminars. By using those teaching materials teachers could conduct the teaching and learning process more efficiently. Students enjoyed their learning process because they were involved in observing and doing things. Those teaching materials also improve students' motivation and interest in learning the materials. Although there were may kinds of teaching materials that have been developed through those Lesson Study activities, there still more topics that need to have or to have better teaching materials. Therefore lecturers from three universities need to have further collaborative work to develop more teaching materials in the future.

Further, the study also recommended that to improve the quality of mathematics and sciences education, the central government needs to: (1) implement more suitable curriculum i.e. more simple and flexible one, (2) redefine the role of the teachers i.e. teachers should facilitate students' need to learn, (3) redefine of the role of principals; principals should support the professional development of teachers by allowing them to attend and participate in scientific, meetings and trainings, (4) redefine the role of schools; schools should promote school-based management, (5) redefine the role of supervisor; the supervisors need to have similar background with the teachers they supervise in order to be able to do academic supervision, (6) improve teachers' autonomy to innovate mathematics and science teaching and learning, and (7) promote better collaboration between school and university; communication among lecturers and teachers should be improved; these could be done through collaborative action researches and exchange experiences through seminars and workshops, (8) redefine evaluation system, and (9) to extend project for promoting new paradigms and educational innovations.

The Lesson Study project was proven to be very effective in lifting students' enthusiasm in learning science, helping students to develop their experimental and discussion skill, giving opportunities to students in developing their own scientific concept by themselves. It was also reported that by using constructivism approach, the students may find out their best style of learning. Competition rises among groups of students in presenting the results of their work and defending their presentations. This forces students to learn theory more on their own. As a result of Lesson Study activities there were many teaching material developed either by lecturers and teaching together or by lecturers or teachers themselves. Those materials were either developed by lecturers or teachers in their own classroom or by lecturers and teachers together during Lesson Study activities. In general lecturers and/or teachers developed the teaching materials after thinking extensively what and how to develop teaching materials for a certain topic, and then develop the materials. Further they try out the teaching materials in their classroom and revise those according to the result of the try out.

C. Lesson Study Develops Learning Community

Successful implementation of SISTTEMS has promoted and attracted educators and education institutions across the archipelago to perform it. The Ministry of National Education (MONE) under the auspecies of JICA through PELITA (Peningkatan Kualitas Tenaga Pendidikan SMP/MTs or the Improvement of Junior High School Teachers) extended the piloting of lesson study from 2009 to 2013 in the following three other districts/cities: Padang City under the supervision of State University of Padang in Sumatra island, the Banjar Baru District under the supervision of University of Lambungmangkurat in Borneo island, and the North Minahasa District under the supervision of State University of Manado in Sulawesi island. MONE has also initiated to facilitate 52 TEIs all over the country to implement lesson study for improvement of pre-service program since 2008. In addition, Indonesia University of Education has succeded dissemination of lesson study in 16 districts of West Java

Provinces through school-university partnership project. Now, Jambi Province in Sumatra island is interrested to adopt West Javas' success story of lesson study.

In Yogyakarta the Lesson Study began with a limited number of schools and teachers of mathematics and sciences only, but has expanded to reach more schools and teachers of other subjects. Involvement of MGMP, which stands for Musyawarah Guru Mata Pelajaran. MGMP is organized in each kabupaten/kota and the MGMP Committee members are elected from among member teachers. The Committee consists of Chairperson, Secretary, Treasurer, Coordinator for activity program, Coordinator for material development, amd Coordinator for Reporting/Publication. The MGMP activities have been arranged as follows: Monday for Civics, Indonesian Language, and Religious Education; Tuesday for English; Wednesday for Mathematics; Thursday for Social Studies, History, Geography, Economics, Anthropology; Friday for no LS activity; and Saturday for Science, Chemistry, Biology, Physical Education.

The MGMP-based lesson study was conducted in 2007, participated by 331 JHS teachers of Mathematics and Science from 34 JHSs located in 17 sub-districts of the Bantul District. The activities were organized as follows: teachers of Mathematics met once in two weeks on Thursday (08.00-13.00), while teachers of Science on Saturday with the same duration. These teachers conducted the Lesson Study in eight home bases, with each home base being supervised by two teacher educators from Yogyakarta State University.

It is non-structural organization of teachers, whose esablishment is stipulated in the Government Regulation No. 38/1994 on Education Personnel. It is a professional forum for subject teachers at the kabupaten/kota (district/city) level. According to the guidelines issued by the then Directorate General for Primary and Secondary Education, Ministry of National Education (now the Ministry of Education and Culture). Through lesson study activities, MGMP has noted some achievement of teachers' professional development: encouraging of teachers to improve theri ability and skills to plan, implement and evaluate teaching and learning activities; developing of discussion activities to solve the problems faced by teachers to carry out their daily responsibilities and to propose solutions in accordance with the characteristics of the subject matter teachers, school conditions, and communities; providing teachers with opportunities to share information and experience about the curriculum implementation and the development of science and technology; providing teachers with opportunities to ex[ress their ideas at MGMP meetings to improve their professional skills; and developing cooperation with other institutions to develop a conducive, effective and enjoyable teaching and learning processes.

In Yogyakarta the Lesson Study began with a limited number of schools and teachers of mathematics and sciences only, but has expanded to reach more schools and teachers of other subjects. This is summarized in the Table 2 below.

Table 2: Data on the Developments of the Lesson Study in Yogyakarta

Year	Number of Schools (JHS and SHS)*	Subjects Studied	Comment
2001	21	One school for one subject only	Piloting Lesson Study simultaneously supported by Teaching Material development at University It seemed to emerge the culture of collaboration and communication among faculty members
2002	42	One school for one subject only	
2003	3 JHSs + 3 SHSs	Mathematics and Basic Sciences in each school	In this phase, the data were collected as the results of monitoring the Piloting
2004	105 new schools in one regency	Mathematics, Natural Sciences, Biology, English, Social Science, Javanese Language, Civics, Islamic Religion, Art and Culture, Physical Education	Involvement of Subject Teachers' Organizations It seemed to emerge the commitment of all sides to implement Lesson Study
2005	115 school in two regencies	The new scheme of : Plan-Do-See was developed i.e. one Plan for some Do	The new scheme is perceived as local creativity. It seemed to emerge the culture of collaboration among the teachers
2006	All public and Islamic JHSs in the Bantul Regency	Up to the devastating earthquake	Due to the earthquake, the culture of collaboration among the teachers was extended and intensified. Islamic School-based Lesson Study is perceived as

			nurturant effect of the implementation of Lesson Study.

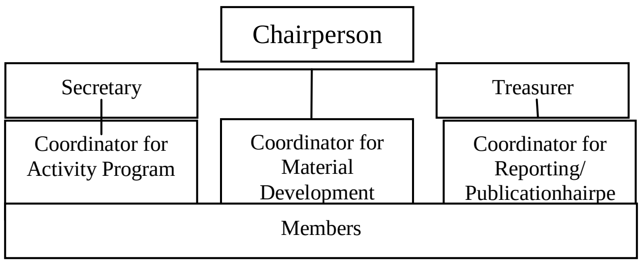
*) JHS = Junior High School; SHS = Senior High School

Table 2 shows the involvement of MGMP, which stands for *Musyawarah Guru Mata Pelajaran*. It is non-structural organization of teachers, whose esablishment is stipulated in the Government Regulation No. 38/1994 on Education Personnel. It is a professional forum for subject teachers at the *kabupaten/kota* (district/city) level. According to the guidelines issued by the then Directorate General for Primary and Secondary Education, Ministry of National Education (now the Ministry of Education and Culture). MGMP has five objectives:

1. To encourage teachers to improve theri ability and skills to plan, implement and evaluate teaching and learning activities;
2. To discuss problems faced by teachers to carry out their daily responsibilities and to propose solutions in accordance with the characteristics of the subject matter teachers, school conditions, and communities;
3. To provide teachers with opportunities to share information and experience about the curriculum implementation and the development of science and technology;
4. To provide teachers with opportunities to ex[ress their ideas at MGMP meetings to improve their professional skills; and
5. To develop cooperation with other institutions to develop a conducive, effective and enjoyable teaching and learning processes.

As mentioned before, MGMP is organized in each *kabupaten/kota* and the MGMP Committee members are elected from among member teachers. The Committee consists of Chairperson, Secretary, Treasurer, Coordinator for activity program, Coordinator for material development, amd Coordinator for Reporting/Publication. The MGMP organizational structure is illustrated in Figure 1 below.

Table 3 : The Organizational Structure of MGMP



The MGMP activities have been arranged as follows: Monday for Civics, Indonesian Language, and Religious Education; Tuesday for English; Wednesday for Mathematics; Thursday for Social Studies, History, Geography, Economics, Anthropology; Friday for no LS activity; and Saturday for Science, Chemistry, Biology, Physical Education.

III. LESSON STUDY PROMOTES TEACHERS' PROFESIONAL DEVELOPMENT

In the academic year of 2008/2009 up to the present time, the lesson study scheme has been developed. As has been mentioend before, it consists of three main steps: *Plan* (preparation), *Do* (Implementation and observation), and *See* (reflection/review). The Plan stage covers the following activities: reviewing the syllabi, developing the lesson plan, developing student's worksheets, developing the observation sheet, and preparing class management. The teachers do the planning through workshops. In the Do stage, one of the teachers in a group implemented the lesson plan, while other teachers observe. They observe what the teacher is doing, what the students are doing, the teacher-students and student-student interaction patterns, the students' activities either as their being responsive to the teacher tasks and as initiators. In the See Stage, teachers are involved in a meeting attended by model teachers, supervisors, oberevers, and stakeholders. This meeting is aimed at providing the participants to reflect on the lesson implementation and then find ways of improving the teaching and learning quality. In the period oa April 2007 to June 2008, each Lesson Study Home Base carried out 12 Lesson Study activities as planned. Since the results were found promising, a new scheme was developed, i.e. 3-4 Plans to be followed by 6-7 Do and See activities.

The lesson study activities covered developing teaching materials and utilized a mathematical modeling of the disaster processes and impact so that students could learn both mathematics and the nature of the disaster. The Lesson Study activities proved to be effective in lifting students' enthusiasm in learning science, helping students to develop their experimental and discussion skills, and in giving opportunities to students in developing their own scientific concepts by themselves. It was also reported that by applying the constructivism approach, the students could find out their best style of learning. Competition rose among groups of students in presenting the results of their works and in defending their presentations. This forced students to learn more theory for their own sake. As a result of Lesson Study activities there were many teaching materials developed either by lecturers or by teachers. Those materials were either developed by lecturers or teachers in their own classrooms or by lecturers and teachers altogether during Lesson Study activities. In general, lecturers and/or teachers developed the teaching materials after thinking extensively what and how to develop teaching materials for a certain topic, and then developed the materials. Further, they tried out the teaching materials in their classrooms and revised those based on the result of the try out. Success stories of the implementation of the lesson study to the teaching of mathematics and science have encouraged teachers of other subjects to implement it in their classrooooms. This has changed the ways teachers and students think and do during the teaching and learning processes. They become ready to learn from one another and share what they have learned for more effective learning. In short, improvement has been achieved together and the achievement has been achieved collectively.

To provide evidence of the lasting impact of the lesson study activities, a research study has been conducted in 2013. In this study data on the impact of the lesson study activites were collected through questionnaires to be filled in by teachers, students, and principals, interviews with teachers, students and principals, observations of the lesson study activities cycles, and achievement testing. Through lesson studies activities, the indicators of teachers' professional development seemed to be improved, i.e.: teachers participation 60% – 75 % , the teachers be more concerned about their students differences; the teachers strived to facilitate students activities; the teachers employed various method of teaching; the teachers employed various method of evaluation; the teachers strived to connect the relationship among Subject-Matter; the teachers developed Contextual Teaching Learning (CTL) approach; the teachers developed various interaction; the teachers employed small group discussion; the teachers developed the scheme for competences achievement; the teachers facilitated their students to be more active; the teachers employed various teaching aids; the teachers employed various learning resources; the teachers strived to implement new paradigm of teaching; the teachers were more passion to facilitate their students; the teachers have their habit to reflect their experiences of teaching; the students were more interested to learning object; the students were more motivated to engage in teaching learning processes; the students were more active in the class.

With these findings, both teacher educators and teachers may be more convinced that improvements in both pre-service and in-service teacher education may be achieved through the Lesson Study strategy by empowering the MGMP. Lesson Study was to be perceived as a useful and effective framework to develop teachers professionalism by performing their accountability and sustainability of teaching, through collaboration among the sides of educational practices consist of teachers, supervisor, lectures and stakeholders. The seminar on the results of the lessson study activities have been found useful as a means of: sharing the results of the lesson study for all groups, teachers, lecturers, and stakeholders; sharing any common problems found during thelesson study implementation; sharing any good solutions to the above problems, and reporting and sriting the finasl resutls of the lesson study implementation as well as its possibility to expand it into a wider scope of both teachers and schools.

IV. LESSON STUDY AND CURRICULUM DEVELOPMENT

In the School-Based Curriculum, it was stated that mathematics in primary and secondary school should encourage the students to think logically, analytically, systematically, critically, creatively and be able to collaborate with others. The implementations of primary and secondary mathematics curriculum in class-rooms need to develop problem solving skills covering both closed and open problems. In solving the problems, students need to creatively develop many ways and alternatives, to develop mathematical models, and to estimate the results. Contextual and realistic approaches are recommended to be developed by the teachers to encourage mathematical thinking in primary schools. With these approaches, there is a hope that the students step-by-step learn and master mathematics enthusiastically. To make their teaching learning of primary mathematics more effective, teachers also need to develop resources such as information technology, teaching aids and other media.

The curriculum outlines the aims of teaching learning of mathematics are as follows: (1) to understand the concepts of mathematics, to explain the relationships among them and to apply them to solve the problems accurately and efficiently, (2) to develop thinking skills to learn patterns and characteristics of mathematics, to manipulate them in order to generalize, to proof and to explain ideas and mathematics propositions, (3) to develop problems solving skills which covers understanding the problems, outlining mathmatical models, solving them and estimating the outcomes, (3) to communicate mathematics ideas using symbols, tables, diagrams and other media, and (4) to develop appreciations of the uses of mathematics in daily lifes, curiosity, consideration, and willingness to learn mathematics as well as tough and self-confidence.

A. Developing the Scheme

National Standard of Education suggests that the teachers need to develop their teaching in such that their students are able to learn mathematics optimally. It also encourages the teachers to develop various methods of teaching; they are expected to develop teaching aid, student's work sheets, and assessment method. Teachers need to be able to facilitate students' learning mathematics. Therefore, contextual teaching approach and realistic approach are recommended to be used. As the impact of government programs to innovate education and international trend of educational reform, the teachers are also expected to develop many kinds of educational research. Observing students' behaviors when they interacts with surrounding objects or people, may be the starting point to discuss about the mechanisms of their mathematical thinking. In the classroom activities the students may look at the object, take hold of it, listen to the sound or talk to the people; more than just these, she may also categorize, memorize or even make the plan for a certain mathematical thinking. Such behavior is taken for granted, much is automatic, yet for it happen at all requires the utilization of complex cognitive processes.

A series of Lesson Study activities may be thought of as constituting a set of culturally organized activities carried out by teacher or a group of teacher to promote children's mathematical thinking. Many small group activities are flexible and do not have a clear end point, predetermined by the teacher. However, small group discussions offer an interesting context in which to explore the participation of children interacting among the others in naturally occurring open ended thinking. In general, when a task has a clear end point, it has been assumed that the children were thinking towards that point. These series of studies were particularly interested in the attitude and method to which the students develop mathematical thinking to learn mathematics. Experience indicates that teachers can employ Lesson Study to promote mathematical thinking. Teacher is perceived to be the subject of the research as well as to be the researcher. By proposing planning, doing and seeing, the study expected to uncover the aspects of students' mathematical thinking.

Table 4: Developing Scheme for Teaching Learning Processes

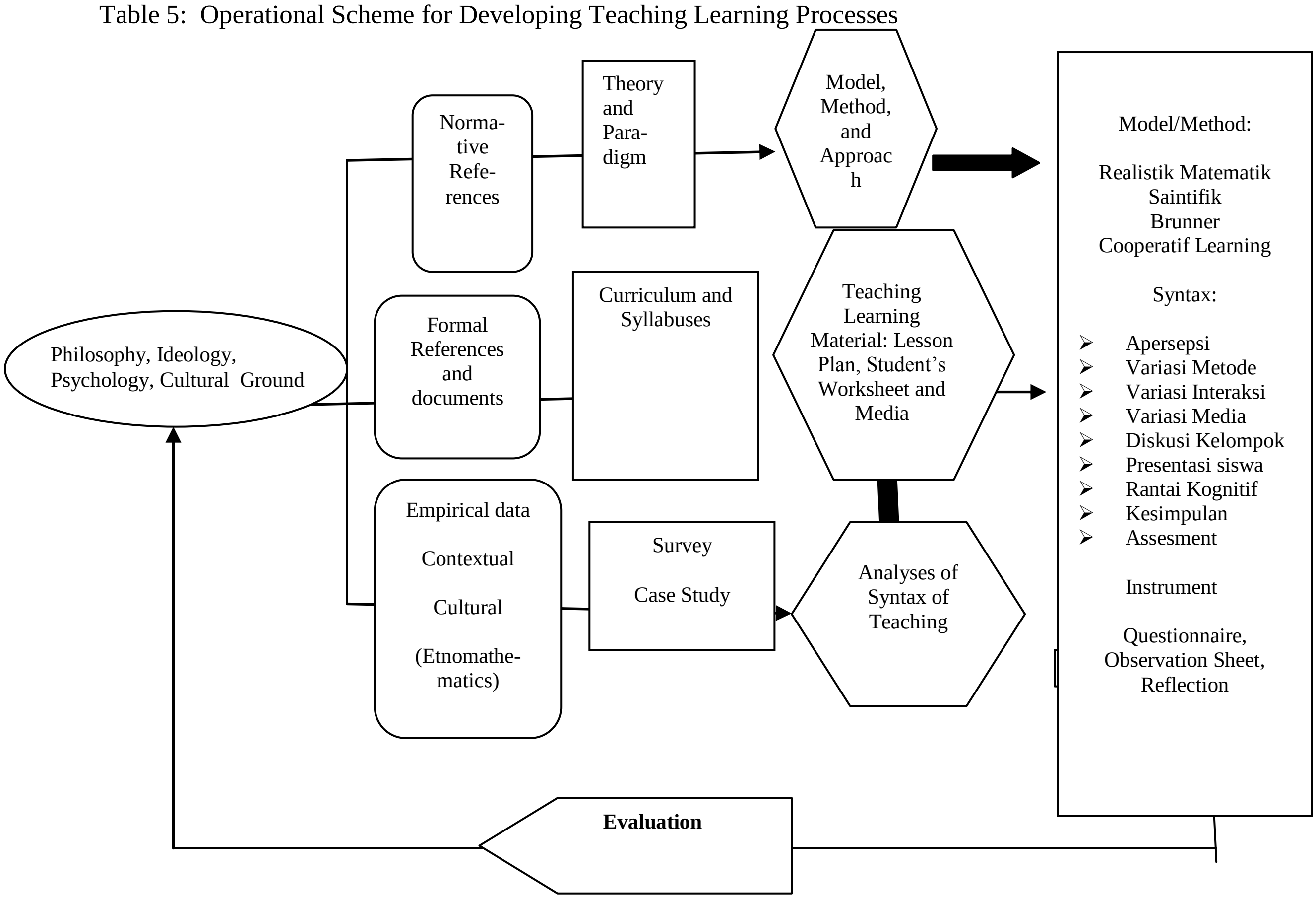
<table>
<tr><th colspan="2">Ground/ Foundatio</th><th colspan="2">Reference</th><th>Paradigm /Theor</th><th>Approaches/ Strategy</th><th>Model Tea Learning</th><th>Teaching/Learning Resources</th></tr>
<tr><td rowspan="6">Philosophy of Education</td><td rowspan="6">Ideology of Education</td><td rowspan="6">Normatif References
Book
Joural
Research</td><td rowspan="6">Formal Refereces
Legal Formal
PP, Permendikbud Kur 2013</td><td>Paradigm / Theory 1</td><td>Approaches/ Strategy/ Method 1</td><td>Model T/L 1</td><td>Lesson Plan
Student Worksheet
Assessment 1</td></tr>
<tr><td>Mix</td><td>Mix</td><td>Mix</td><td>Mix</td></tr>
<tr><td>Paradigm / Theory 2</td><td>Approaches/ Strategy / Method 2</td><td>Model T/L 2</td><td>Lesson Plan
Student Worksheet
Assessment 2</td></tr>
<tr><td>Mix</td><td>Mix</td><td>Mix</td><td>Mix</td></tr>
<tr><td>Paradigm / Theory 3</td><td>Approaches/ Strategy/ Method 3</td><td>Model T/L 3</td><td>Lesson Plan
Student Worksheet
Assessment 3</td></tr>
<tr><td>etc</td><td>etc</td><td>etc</td><td>….</td></tr>
</table>

				Paradigm /Theory 2013	Approaches/ Strategy/ Method Kur 2013	Model T/L Kur 2013	Lesson Plan Student Worksheet Assessment Kur 2013

B. Implementation

Students' interactions with adults and among themselves may promote complex cognitive processes in the form of mathematical thinking. The context in which tasks are performed has begun to form a significant aspect of analysis, it has been interpreted in a variety of ways, sometimes in very local terms, to refer to the conditions under which a particular task is performed, or a particular mathematical thinking is produced. A wider view suggested that the aspect of students' mathematical thinking offers a variety of potential meanings and interpretations, and that mathematical thinking involves a negotiation of shared context. Mathematical thinking happens in the context of teaching learning processes. Group discussion based on principles of promoting children's growth and development through play activities may encourage the students to explore, experiment, question, and talk. Teacher's efforts to facilitate their students to find various patterns of mathematical content can be seen as consistent with extending the students' experiences of mathematical thinking and encouraging social interaction among them.

Table 5: Operational Scheme for Developing Teaching Learning Processes



Marsigit (2010) aimed the study of lesson study to promote *mathematical thinking* of primary and secondary students. The study provided teachers the opportunity to see teaching and learning in primary and secondary mathematics classroom in a real context. The study guided the teachers to focus on planning, implementation, observation, and reflection of their mathematical teaching in such away that their students were to perform *mathematical thinking*. By looking at real contexts of mathematical teaching learning processes, the researcher and the teachers were able to develop a common understanding of what should be planned, done and reflected to promote mathematical thinking. The study also provided opportunities for teachers to carefully examine students' *mathematical thinking* by observing and discussing real mathematics problems. The study was in the form of *School-Based Lesson Study* in which some teachers of Primary and Secondary Schools were participated to establish lesson study goal and develop lesson study cycles by developing common vision of systematic and consistent pedagogical approach to facilitate students need in performing their mathematical thinking. The steps of developing School-Based Lesson Study covered recruiting teachers, developing the theme, planning the Lesson Study, preparing observation and reflecting the results.

1. First Lesson

At the first lesson study activities composed of 4th-grade teachers and 5th-grade teachers of Primary Schools and 8th-grade teachers of Junior High Schools who work in three different schools: SD MIN I Yogyakarta, SD Percobaan Bulaksumur Yogyakrta and SMP N II Depok Yogyakarta. The researcher facilitated the teachers to provide perspective and a broader view of the issues as well as to serve as outside commentator, evaluator, or outside advisor. The researcher emphasized that the selected teachers should come in with the mindset of being a learner and ready to share and to communicate findings. The researcher and the selected teachers built open communication and set time-table for the related activities. The lesson study theme captures the school goals as well as the academic content goals for students to develop approaches and to perform *mathematical thinking*. The researcher exposed the important of mathematical thinking in the sense of students' thinking, educational theories, and international trends. The selected teachers choose a subject area in which to focus on *mathematical thinking*. They needed to identify a unit or lesson on which to focus on *mathematical thinking* and thoroughly discuss the unit and agree about what they are trying to achieve with the lesson. They also needed to expect what did they want students to know and be able to perform mathematical thinking. The researcher strived that the selected teachers must understand how their lesson would significantly supporting and facilitating mathematical thinking. To achieve this goal the researcher carried out firstly the socialization of Katagiri's notions of mathematical thinking. Prior the study implementation, the researcher shared and discussed with the teachers to prepare lessons related to the topic. The researcher and the selected teachers developed the lessons and set the stage for the observation in which the lesson and the learning processes would be reflected. A piece of planning the lesson included the schema of student responses to various aspects of the lesson and preparing appropriate teacher responses as well as the logical implication of mathematical thinking.

There was conformity among the goal of the overall Lesson Study, the aim of teaching and the aim for student learning. The researcher and the selected teachers developed lesson design and lesson plan to bring these goals. The developed Lesson Plan referred to the School-Based Curriculum (KTSP). The selected teachers implemented teaching learning processes while the researchers collect data on students' mathematical thinking and their aspects. Some other teachers and the researcher were set to observe the study lesson in a scheduled time and place. The researcher and the selected teachers shared the data collected covering of the evidence that goals for promoting students' mathematical thinking; and then found out the solutions of how to improve the lessons. Lesson debriefing was proposed to give the chance for the selected teacher to reflect his/her teaching; while getting inputs from other teachers or researcher. In while teaching, the researcher collected the data that need for debriefing. The data covered the comments of students and the work students produce during the lesson. At some occasions the researcher needed to observer closely the work and comments of particular students. The researcher and the selected teachers prepared copies of the lesson plan, teaching aids, and any students' worksheets that students would be using. The study prepared the classroom so that the observers can circulate freely among students during whole-class teaching. The researcher developed instrument to investigate the structure of lesson, the schema of interaction, and the schema of mathematical thinking in the frame of the effort of achieving the mathematical competences.

It was not always easy for the teacher to start initiating the students to think mathematically on the problems of understanding the Least Common Multiple (LCM) and determining the Least Common Multiple (LCM). At a certain occasion, the students seemed to not be able to grasp teacher's expectation of *mathematical thinking*. When the students were not able to take examples, the teacher posed the prepared problems. In group discussion, *mathematical thinking* was always started when the teacher posed the prepared problems written in the Work Sheet. There was a high spirit when the students found out the relevant references and resources to solve the problems. The students employed their pre-requisite knowledge of Calendar to find the pattern and relation i.e. from the problem of finding *the multiple of 7 days and the multiple of 8 days in one year.* Additional skill might have been a supporting factor that the students by themselves employed various aids to solve the problems such as calendar, hand-phone, and blank table prepared by the teacher. In the effort of identifying or describing the specific mathematics, the students found the routine activities there are the concept of addition and subtraction i.e. 7 + 7 + 7 + 7 …. or subtracting by 7 (for swimming); 8+8+8+8+8…. or subtracting by 8 (for gardening). The concept of "frequency" emerged when there was a question of " how many times common activities". The concept of "frequency" was interpreted as the concept of "repeating addition or subtraction" i.e. the concept of multiple of number such as - *For 10 month, Shinta goes to swim 10 x 5 = 50 times; - For 10 month, Shinta goes to gardening 10 x 4 = 40 times.* In the effort of schematizing, formulating and visualizing, the students employed different ways to indicate that there are various ways in determining the multiple number of 7 and 8 e.g. using calendar, using series of numbers, using calculator and manipulating different symbols for 7 and 8. The students employed different schemas on determining the common multiple of 7 and 8 i.e. some students calculate the multiple of 7 for the whole year first then multiple for 8; and followed by counting the number of common activities in one year. Some students indicated first the common multiple of 7 and 8 (i.e. 56) and then counting the number of common activities in one year.

In the effort of to think mathematically on the problems of understanding the Least Common Multiple (LCM) and determining the Least Common Multiple (LCM), the series of sentences produces by the group indicated first *horizontal mathematization* then followed by *vertical mathematizaion*. Most of the students employed subtraction, addition, multiplication and division to list multiple of 7 and 8. They indicated Common Multiple , as the mathematical concepts to answer the common Shintas activities in one year. Students' reflection of *mathematical thinking* employed transition from daily language of mathematical language i.e. from common activities to common multiple. There was a student who jumped their concept to LCM due to he got it from *"informal private lesson*". In performing the *Vertical Mathematization* the students need the assistances from the teacher. The teacher encouraged the students to list more the multiple of 7 and the multiple of 8 and encouraged them to indicate the common multiple of 7 and 8. In the effort of discovering relations, the students discovered the relationship between "common activities" and "common multiple" i.e. 7 days and 8 days compare with "multiple of 7 and 8 = 56". In the aspect of discovering regularities, the students found that the concepts of regularities arouse from the concepts of "routine activities". The students recognized the isomorphic aspect in different mathematics problems i.e. the regularities emerged from isomorphic activities such as "swimming" and "gardening", "study club", "laboratory activities" or "going to library". There are the key concepts reflecting by the key word of how the students can transfer the real world problems to mathematical problem e.g. the concepts of "common", "regular", "routine", "number of", etc. Students' thinking of the concept of LCM were much contributed by teacher's employing real-life contexts as a starting point for their learning and simultaneously affected by the use of their own productions of formulas and strategies. In thinking the concept of LCM, interactions between teacher and students, students and students are the essential activities. Students' thinking of the concepts of LCM were influenced by the connection among the strands of mathematical concepts developed previously e.g. the concept of factor of numbers and by the connection with meaningful problems in the real world.

2. Second Lesson

At the second lesson study activities The subjects of the study were the 5th grade students of Primary School. The aim of the research was to promote mathematical attitude through teaching learning the Volume of Cube and Rectangular Parallelepiped. The aim of the lesson was to encourage the students to find the volume of Cube and Rectangular Parallelepiped and applying them to solve related problems. The specific aim of the lesson were to find the volume of Cube and Rectangular Parallelepiped and to solve the problems related to the volume of Cube and Rectangular Parallelepiped. Most of the students strived very hard to understand the concepts of Pyramid, Prism, Cone and Cube (Lesson Object). There are some ways in which the students strive to understand the concept: manipulation of the Model of Three Dimensional Geometrical Object, questioning to the teacher, questioning to other students, manipulation of mathematics net. Some students got the concept of geometrical shapes from informal learning i.e. from their parents or from additional lesson outside the school. The students were able to indicate the similar of geometrical shapes in daily lives; they also tried to identify the function of identical geometrical shape in daily live. The students perceived that their teacher has important role in helping them to perform *mathematical thinking.*Different geometrical shapes have different level to be understood. The concept of a cone was the most difficult for the students to understand. The students have difficulties how to calculate the number of the side of the cone. To solve the problems some students delivered the questions to the teacher and the other asked to their classmates. The students tried to employ their pre-requisite knowledge in clarifying the difficult concepts. Some students developed the step in order to understand the difficult concepts i.e. by asking first about the nature of the concept of a cone and then to ask to the teacher about its characteristics. However, some students inevitably jumped without any pattern due to have no systematic knowledge of geometrical shapes. There were the students who tended to be silent and passive if they still do not understand the difficult concepts. Students' effort to understand the difficult concept of geometrical shapes depended on the context and the schema of teaching. If the teacher communicate with the students in less formal, the students felt have no constraint to ask to their teachers. Some students perceived that their teacher should provide the complete and good quality of teaching aids. However, they also perceived that they enjoy getting assignments from the teacher. Most of the students employ inductive thinking i.e. by trial and error to answer teacher's questions; some of them tried to sketch the geometrical shapes and compare with different size of the models. The students tended to re-state the explanations and get attention from their teacher and their classmates to confirm whether their ideas were true.

3. Third Lesson

At the third lesson study activities, the subjects of the study were the 8th grade students of Junior High School. The aim of the lesson was to understand the characteristics of cylinder, cone, sphere and to determine their measures. The specific aims of the lesson were to identify the formula of the total area of right circular cylinder and to identify the formula of the area of sphere. The students manipulated *Concrete Mode*l of the *Right Circular Cylinder, Sphere and Right Circular Cone* in order to identify its components. They performed *mathematical abstractions* when the teacher gave them some questions or when the teacher let them to work in group. Some students defined the *concept* of *Right Circular Cylinder* as its *functions* in daily life e.g. *"A Right Circular Cylinder is the storage to keep something like pen, pencil, etc."* There were students who defined *a Sphere* by giving the example in daily life e.g. ball, tennis-ball, etc. Students' *abstractions* of Sphere resulted the investigation of its components i.e. the *radius* and *diameter*. There were many ways in which the students *idealized* the geometrical concept. They mostly confirmed the concept to the teacher and asked to their mates. Sometimes they performed their *idealization* by commenting others work. Some students asked to the teacher why the *lateral area of cylinder is equal to the area of its rectangle* and why the *volume of cylinder is equal to three times the volume of its cone? Analogical thinking* happened when the students perceived that finding the lateral area of *Right Circular Cylinder* is similar to finding the area of its rectangle; and, finding the area of *Sphere* is similar to finding the area of its surface i.e. covering its surface by twisting around with the rope. In sum, the concepts of geometrical shapes are mostly perceived to be analogical with examples in daily life e.g. the *right circular cone was perceived* as a *traditional hat.* In performing their *analogical thinking* the students frequently used strategic terminologies such as *"similar to", "compare with", "the example of",* and *"the function of".* Students' *inductive thinking* involved *Concretization and method of abstraction* in the area of *problem formation* and *comprehension.* When the students, they who had known the certain concepts, were paced to perform *inductive thinking* they tend to reconfirm their concepts. *Inductive thinking* was spread from the beginning activities to the ultimate accomplishment when the students were paced to do so. The students developed *method of abstraction* to observe the given model of right circular cylinder and strived to identify the components of the right circular cylinder in order to define the concept of right circular cylinder. Students' *inductive thinking* were also related to *establishing perspective* in which the students employed concrete model to search the total area of right circular cylinder and brook-down the model of right circular cylinder into its components: two congruent circles and one oblong.

Logical organization of mathematical concept happened in all context of mathematical method: *idealization, abstraction, deduction, induction and simplification. Logical organizations* of mathematical concept can be indicated from the following example of students' questions: Why the lateral area of cylinder is equal to the area of its rectangle?, Why the volume of cylinder is equal to three times the volume of its cone?, What happened if we do not carefully cover the surface of the sphere in which we use the rope for twisting around?, and Is it true that that the area of the surface of sphere is equal to 4 times the area of its circle? Problem *formation* and *comprehension* emerged when the students: observe given model of right circular cylinder, observe given model of Sphere, and observe given model of right circular cone; identify the components of the right circular cylinder, sphere and right circular cone; define the concept of right circular cylinder, sphere and right circular cone; and get questions and notices from teacher to search the concepts. The evidences indicated that, in term of the realistic approach, mathematical thinking can be performed through identifying or describing the specific mathematics, schematizing, formulating and visualizing a problem in different ways, discovering relations, discovering regularities, recognizing isomorphic aspect in different problems; transferring a real world problem to a mathematical problem. Mathematical thinking was always started when the teacher posed the prepared problems written in the *Work Sheet*. The students employed their pre-requisite knowledge to perform mathematical thinking. The students employed different ways to perform *schematizing, formulating* and *visualizing.* The series of sentences produces by the group indicated first *horizontal mathematization* then followed by *vertical mathematizaion*. In performing the *vertical mathematization* the students need the assistances from the teacher.

The students recognized the *isomorphic aspect* in different mathematics problems i.e. the key concepts reflecting by the key word of how the students can transfer the real world problems to mathematical problem. Students' thinking of the concepts of mathematics was influenced by the connection among the strands of mathematical concepts developed previously. The students tried to employ their pre-requisite knowledge in clarifying the difficult concepts and developed the step in order to understand the difficult concepts. Most of the students employ *inductive thinking* i.e. by trial and error to answer teacher's questions; some of them tried to sketch the geometrical shapes and compare with different size of the models. The students tended to re-state the explanations and get attention from their teacher and their classmates to confirm whether their ideas were true. There were many ways in which the students *idealized* the geometrical concept. Students' *inductive thinking* involved *concretization and method of abstraction* in the area of *problem formation and comprehension.* When the students, they who had known the certain concepts, were paced to perform *inductive thinking* they tend to reconfirm their concepts. *Inductive thinking* was spread from the beginning activities to the ultimate accomplishment when the students were paced to do so. Students' *inductive thinking* were also related to *establishing perspective* in which the students employed concrete model to search the total area of right circular cylinder and brook-down the model of right circular cylinder into its components: two congruent circles and one oblong. *Logical organization* of mathematical concept happened in all context of mathematical method: *idealization, abstraction, deduction, induction and simplification. Problem formation* and *comprehension* emerged when the students observe mathematical models.

V. RESULTS

The implementation of the lesson study proves the improvement of teaching mathematics and teachers professional development. Lesson study activities promotes the new perspective of teaching in term of its philosohy, ideology, psychology and cultural ground. This has changed the ways teachers and students think and do during the teaching and learning processes. They become ready to learn from one another and share what they have learned for more effective learning. In short, improvement has been achieved together and the achievement has been achieved collectively. The impact of the lesson study activites to mathematics teachers covers its readiness and its competencies of teaching i.e. the validity of its lesson plan and students worksheets, students' motivation and apperception, flexible method and approach of teaching, small group discussion, various method of teaching, various media, various interaction, teaching scheme, assessment, students' reflection, students' initiation, and students effort in constructing their mathematical concepts. With these findings, both teacher educators and teachers may be more convinced that improvements in both pre-service and in-service teacher education may be achieved through the Lesson Study strategy by empowering the MGMP. It can be concluded that through lesson study, the teachers are to perform better in managing classroom and in promoting their professional development. The teachers have the clear picture on the effective framework to develop teachers professionalism by performing their accountability and sustainability of teaching, through collaboration among the sides of educational practices consist of teachers, supervisor, lectures and stakeholders. Good athmosphere for teaching innovation can be maintained through various activities e.g. by sharing the results of the lesson study for all groups, teachers, lecturers, and stakeholders; sharing any common problems found during thelesson study implementation; sharing any good solutions to the above problems, and reporting and sriting the finasl resutls of the lesson study implementation as well as its possibility to expand it into a wider scope of both teachers and schools.

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The Scientific Approach To Higher Education:

Examples From Physics Education Research

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Economic development hinges on the scientific and technical preparation of future workers. In particular, training in physics teaches critical thinking, quantitative reasoning, and hands-on technical skills. It is obvious that the adequate preparation of teachers of science is essential. In spite of its importance, the traditional preparation of students in the field of physics has been found to be inadequate in teaching conceptual knowledge (Hake, 1998). While Indonesia has made great strides in improving literacy and school enrollment (Ahlburg, 1997), teaching methods have not evolved at the same pace. Whereas university level education in the fully developed economies is moving to a more student oriented mode, the Indonesia classroom remains more teacher centered (Frederick, 2011).

Many emerging economies, including Indonesia, have called for improved science education. Indeed, studies show that pedagogical reform can be cost effective in improving learning in the emerging economies (Kremer, 2013). Indonesia has experimented with such educational improvements as hands-on experimental kits for primary and secondary school classrooms (Zurcher, 2013), as well as professional development innovations, such as lesson study (Suratno, 2013; Saito, 2006). Some programs have been partnerships between schools and universities (Saito, 2007). However, the majority of these experiments in reform have been aimed at improving primary or secondary education, indicating a need to examine methods at the university level.

Yogyakarta State University (UNY) has a history of involvement in educational reform and experimentation. Faculty at UNY were directly involved in experiments in reform in science education at the secondary level (Saito, 2006; Saito, 2007). The University has one of the most respected teacher training programs in Indonesia, as well as technical programs of study in the field of physics. In addition, the city of Yogyakarta is a center of higher education in Indonesia, with several institutions of higher learning, thus giving access to many educators and professionals in the field of higher education in Indonesia.

Properly used, hands-on activities have been shown to increase conceptual learning (Hoellwarth, 2005). The topics of motion, mechanics, basic electric circuits, and optics can be effectively demonstrated with simple and often readily available components. See Gupta, 2010 (web link available in references listed at end of proposal) for an inspiring example of how this can be achieved in an emerging economy. Designed to be simple in execution, but conceptually engaging, each activity challenges students to solve a problem or to explain a simple demonstration. For example, one lesson in optics requires students to place a small mirror on the wall so that they can see the image of a piece of tape on their knee in the mirror. The solution (placing the mirror exactly halfway in height between the knee and eyes) requires a working understanding of the principles of reflection and geometry. Some example activities and required materials are listed in the table below.

Topic Of Activity	**Required Materials**
Free fall	String, washers or nuts
Projectile motion	Ball, pieces of tape
Circuits	Battery, short piece of bare wire, small light bulb
Reflection	Piece of mirror, tape

The choice of activities and how they are used in the classroom must be done with the guidance of experienced faculty. The implementation of these activities requires extensive interaction between instructor and small groups, as well as Socratic questioning. Initially, these techniques may not fit the cultural expectations students have of the classroom dynamic. To foster acceptance, the goals and expectations of the activities must be clearly explained to both students and instructors, and the cultural norms of behavior in the classroom must be respected. In addition, any written materials must be reviewed by before administering to reduce possibilities for misunderstanding.

In addition to hands-on inquiry group activities, there are other methods such as pre/post testing (in which student conceptual gains are measured), “just-in-time” teaching (in which pre-class online quizzes are used to guide in-class use of time), and peer-instruction (in which students debate amongst themselves solutions to conceptual questions). Hands-on activities make use of simple and inexpensive materials. Students work in small groups and often report in evaluations that these activities are the most memorable parts of the course for them.

Courses can be structured in a non-traditional format: students work in small groups with hands-on experiments and group problems. Students construct their own explanations of their observations and then debate them in a classroom environment, with the instructor playing the role of moderator.

Understanding which methods are successful and how to implement them will require a science of learning. Fundamental studies must reveal how the brain learns and in particular, how the mind applies concepts in physics, both correctly and incorrectly. Researchers are now developing this science which can only improve our ability to effectively teach at the university level.

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Current Trends In Active Learning In The Sciences

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Indonesia has made great strides in improving access to education for its people. Indonesia is in the midst of educational reform, and faculty members at UNY, have been an active participant in this reform (Saito, 2007). Increasing interest and skills in the fields of science is imperative in a country like Indonesia that is rapidly industrializing. Therefore, it is a priority to increase the number of students and teachers who are proficient in the fields of science, technology, engineering and mathematics.

A recent study (Freeman, 2014) demonstrates that active learning improves student performance in science. Since student involvement is one of the most important predictors of college success (Astin, 1993), it is vital to include these methods in the university classroom. In a country where teaching is more traditional and teacher-centered, convincing instructors of the value of these new methods can have substantial impact.

The term active learning was popularized in the 1991 report to the Association for the Study of Higher Education (Bonwell & Eison, 1991). In order to learn, students must do more than just listen: they must read, write, discuss, or be engaged in solving problems. In particular, students must engage in higher-order thinking tasks such as analysis, synthesis, and evaluation. Active learning engages students in two aspects: doing things and thinking about the things they are doing.

During my presentation I will discuss current active learning techniques and how to implement them in the classroom.

Use of "ABCD Voting Cards" and Peer Instruction

Peer instruction methods consist of brief lecture-style presentations on key points of a topic followed by conceptually-challenging, multiple-choice questions. The student thinks about the question on his/her own and selects an answer. The instructor reacts based on the distribution of votes. A common practice is to ask the students to "turn to your neighbor and convince them you're right." After a discussion, the students vote again, hopefully with a majority of students choosing the correct answer. The instructor confirms the answer and carries on with the lesson.

This process forces students to think through the arguments being developed so they can explain them to their peers. Students learn better and retain knowledge longer when peer instruction is used (Crouch & Mazur, 2001).

In the United States, student polling is often done with wireless audience response technology referred to as "clickers." For the past several years, I have been developing the use of a low cost, but effective alternative to the more expensive clicker technology. "ABCD voting cards" are formed by simply printing multiple choice responses in large type on the four quadrants of a piece of paper. The paper can be folded and presented by the student to display their answer. While not providing an automatic record of individual responses, the method does show quite clearly the rough percentage of correct answers, and clearly shows the most common wrong answer. Individual student responses are visible, allowing the instructor to choose students with correct answers to explain their work to the class, or allowing for the identification of groups of students with misunderstandings.

Group Problem Solving

A similar approached can be followed with problems that require a detailed analysis of a situations (for example, a Clinical case study) or a numerical answer. In a problem solving session, students work in small groups on the solution of a problem. My classes are less than 40 students and I move around the class and help individual groups that are stuck. In larger classes, the instructor can stop the class periodically and give hints to help slower groups. After the session has ended, the instructors, or selected groups, present the correct answer to the class. The cooperation and team work that is practiced in group problem solving improves learning outcomes relative to individual work (Prince, 2004).

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What Can Mathematics Education Contribute To Preparing Students For Our Future Society?

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Abstract

Mathematics education has to prepare students for society, work and further study. One of the goals of education is to support students in developing mathematical skills and understandings that can be used flexibly in new or unfamiliar problem situations. Characteristics of support that contribute to this goal appear to be the integration of open problems and rich contexts that evoke inquiry by students in textbooks, and the careful use of didactic models that link up with students' intuitive inventions. Teachers have an important role in guiding students through these open problems and in introducing these didactic models. To support teachers, such open problems can be accompanied with lesson plans and suggestions for meta-cognitive prompts.

Mathematics education has to prepare students for society, work and further study. However, international studies show that much of what is taught in school seems to be lost when you assess it not immediately after the lessons or in different contexts. An example is a question about fractions in the TIMSS 2003 Study for grade 8 students: A scoop holds 1/5 kg of flour. How many scoops are needed to fill a bag with 6 kg of flour? The international average of a full credit for this item was 38%.

Such low scores must have us reflect on what we teach and how we teach it. Obviously, citizens in current society should not be able to solve this scoop problem by heart, but you would expect that students are able to solve it with pen and paper at hand. The steps underlying the calculation are rather elementary and fundamental for proportional and algebraic reasoning in a wide range of topics in mathematics education at secondary school. Why are students lost when they don't remember the algorithm?

An approach to mathematics education that tries to provide for learning trajectories that support students in understanding and tracing concepts and skills is Realistic Mathematics Education (RME). Rather than beginning with abstractions or definitions to be applied later, this approach starts with rich contexts that ask for mathematical organization [1]. Well-chosen problems offer opportunities for students to learn to inquire and to develop informal, highly context-specific models and problem solving strategies. These informal solving procedures then function as foothold inventions for formalization, generalization and inquiry-strategies. Didactic models that link up with students' inventions are introduced in generalizing activities to promote level raising [2]. As a consequence, during these activities the model and the situations being modelled co-evolve. Modelling in this view is a process of reorganizing both activities and the situation and drives the learning process of the students [3]. The aim of this approach is that students are involved in the (re)invention of mathematics and that they are able to trace the structure and representations of mathematical concepts and skills.

In addition to this learning-oriented importance of the use of rich contexts, the relevancy of what is learned can also be highlighted. Research findings show that students experience and understand the functionality, purpose and utility of disciplinary knowledge in the workplace [4]. For this to happen however, it is important that tasks within workplace contexts also fit the goals of the curriculum. In the context of work the use of science and mathematics can emerge from the activities and tasks of the workplace [5].

Both RME and the connection to the world of work will make mathematics and science more meaningful and relevant to students. In a classroom where students inquire problem situations create mathematical inventions, students take an active role, pose questions, explore situations, find their path to solutions and communicate their reflection. Such approaches aim to promote students' curiosity, engagement and learning in-depth [6]. For this to happen, teachers need to extend their teaching repertoire. One of the challenges for professional development is to connect the learning of new teaching strategies or pedagogies with teachers' practices within the classroom. Teachers should feel the need and have the resources to adopt new ideas and to implement them in their daily practice. Classroom materials, like tasks for students, can play a crucial role in this implementation process.

Tasks have the potential to reflect innovative aims and to inspire and support teachers in implementing these aims [7]. However, whether a teacher recognizes and exploits this potential of a task and how she/he transforms it into her/his teaching is a complex process and highly depends on the adaptability of the task to his or her practice [8]. Well described lesson plans and meta-cognitive prompts appeared to be powerful tools for supporting teachers in implementing new and innovation-oriented tasks [9].
In the Netherlands RME influenced the current textbooks in primary education. The full credit score of Dutch students on the above scoop-item was 74%. This cannot fully attributed to the implementation of RME, but it strengths the feeling that this approach contributes to the quality of mathematics education.

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M – 01

Spatial Extreme Value Modeling Using Max-Stable Processes Approach
(Case Study: Rainfall intensity in Ngawi)

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Abstract**—** Extreme events are short scale phenomena rarely happen, but almost unavoidable and give considerable impacts. Located in the tropical region close to the equator, Indonesia has high variability of rainfall intensities across regions. Prediction of rainfall, particularly the pattern and the characteristic of its extreme intensity, is expected to be able minimizing the loss caused the events. Extreme Value Theory (EVT) is a statistical method commonly used to study the behavior of extreme events in the univariate case. In this study, multivariate series of rainfall intensities from several locations were modeled by means of Max-Stable Processes and spatial extreme value approaches considering the spatial effect. The Generalized Extreme Value (GEV) distribution was employed in Max-Stable Processes with parameters estimation using Maximum Pairwise Likelihood Estimation (MPLE) method. The proposed method was applied to model the extreme rainfall in Ngawi region, East Java, Indonesia. The dependencies of rainfall intensities across location were indicated by the extremal coefficient plot. The best model selected based on Takeuchi Information Criterion (TIC) was used to predict return level of rainfall intensity. In this research, the prediction value of return level showed that the highest rainfall intensity increase in last two years for all stations.

Keywords: *Spatial extreme value, GEV distribution, Max-Stable processes, extreme rainfall, return level*

I. INTRODUCTION

Extreme events are short scale phenomena rarely happen, but almost unavoidable and give considerable impacts. Located in the tropical region close to the equator, Indonesia has high variability of rainfall intensities across regions. Extreme Value Theory (EVT) is a statistical method commonly used to study extreme events in the univariate case.

The EVT has two main approaches, i.e. Block Maxima (BM) and Peak Over Threshold (POT). In fact, many natural phenomena such as rainfall, temperature, and snow are related in several locations. Therefore, the observation of those event collected from several nearby locations may generate multivariate series in the sense of location. The extreme events in such cases can be modeled using spatial extreme value. There are several methods used to analyze spatial extreme value: first, the Copula approach proposed by [1], second, reference [2] had research about precipitation spatial extreme in Colorado using hierarchical Bayesian approach, and the third approach using Max Stable Processes (MSP) developed by [3]. The MSP is the extension of the multivariate extreme value theory to the infinite dimensional setting. It is used for spatial dependence modeling by transforming the marginal distribution of extreme value to the Frechet margin belongs to types of Generalized Extreme Value (GEV) distribution. The MSP has several model commonly used, for example are Smith model proposed by [4] for modeling rainfall intensity in England and Schlather model proposed by [7].

This paper will review the procedure of spatial extreme value modeling using MSP and will be applied for rainfall intensity modeling in Ngawi, East Java, Indonesia. Ngawi region is one of the main rice-producing areas in East Java, with rice production is 776,937 ton. The total harvest area is 120,929 ha where some part located in flood-prone areas [8]. Therefore, the information about extreme rainfall plays important role for early warning system to avoid the huge damage caused by the flood.

II. LITERATURE REVIEW

EVT is a statistical method used to study patterns of tail random distribution developed for univariate case. This research employed BM approach that will be described more detail as follows.

A. Block Maxima (BM)

One of methods used for identifying extreme value is BM which identifies the extreme value based on the maximum value of observations grouped by into certain period. The extreme observations collected by means of BM approach are illustrated in Figure 1.

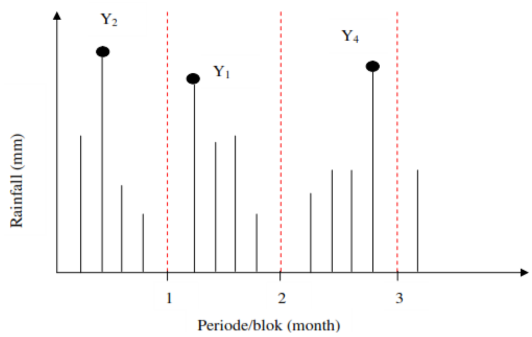

FIGURE 1. ILLUSTRATION OF BLOCK MAXIMA APPROACH

The BM approach applies the Fisher-Tippet Gnedenko (1928) theorem, i.e. the sample extreme value taken from BM will follows the GEV distribution [3]. The cumulative probability function (cdf) of GEV is formulated as follows:

$$F(y;\mu,\sigma,\xi)=\begin{cases}\exp\left\{-\left[1+\xi\left(\dfrac{y-\mu}{\sigma}\right)\right]^{-\frac{1}{\xi}}\right\},-\infty<y<\infty,\xi\neq 0,1+\xi\left(\dfrac{y-\mu}{\sigma}\right)>0\\ \exp\left\{-\exp\left(-\dfrac{y-\mu}{\sigma}\right)\right\},-\infty<y<\infty,\xi=0,\end{cases}\quad (1)$$

where $-\infty<\mu<\infty$, $\sigma>0$, and ξ are location, scale and shape parameters, respectively .

B. Spatial Extreme Modeling.

Natural phenomeda such as rainfall, temperature, and snow are related across close locations. The time series of these phenomena collected from several nearby locations can be considered as multivariate time series. Therefore, the EVT developed for univariate case is not enough. In such a case, the spatial extreme value (SEV) plays into the role. The SEV modeling requires the existence of spatial dependence of the data. The concept of spatial dependence follows Tobler first law, i.e. "*everything related to everything else, but near thing is more related than a distant thing*".

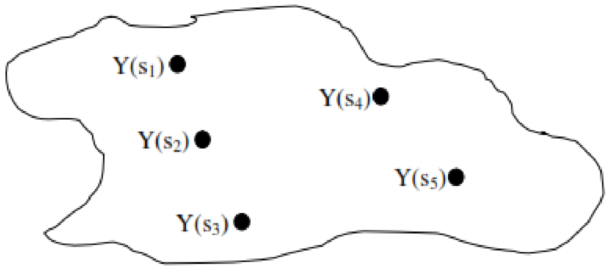

FIGURE 2. ILLUSTRATION OF SPATIAL DATA

The MSP is an approach used for the SEV modeling. The MSP increase the dimension of EVT distribution where samples were taken from the maximum value at each location [2]. It transforms the marginal distribution of extreme value into Fréchet distribution.

Let $M(s,t)$ is data of extreme events in location s and period t. The distribution of $M(s,t)$ is:

$$M(s,t) \sim GEV(\mu(s,t), \sigma(s,t), \xi(s,t)),$$

where $\mu(s,t), \sigma(s,t), \xi(s,t)$ denote location, scale, and shape parameters from GEV distribution, respectively. An arbitrary distribution function G is max stable if and only if G follows GEV distribution.

Let S be an index set and $\{Y_i(s)\}_{s\in S}, i = 1, 2, ..., n$ be n independent replications of the continuous stochastic process. Assume that there are sequences of continuous functions $a_n(s) > 0$ and $b_n(s) \in$ R such that:

$$Y(s) = \lim_{n\to\infty} \frac{\max_{i=1}^{n} Y_i(s) - b_n(s)}{a_n(s)}, \qquad n \to \infty, s \in S, \tag{1}$$

where $Y_1,..,Y_n$ are independent replications of Y. If this limit exists, then (1) is MSP [5]. If $\alpha_n(s) = n$ and $b_n(s) = 0$, then $Y(s)$ is simple MSP [3]. Assume that each component on each location has GEV distribution, do transformation into Frechet margins:

$$F(z) = \exp\left(\frac{-1}{z}\right), \qquad z > 0$$

where Z can be obtained by standardizing $\{Y(s)\}_{s\in S}$ such that:

$$\{Z(s)\}_{s\in S} = \left\{1 + \frac{\xi(s)\left(Y(s) - \mu(s)\right)}{\lambda(s)}\right\}_{+}^{1/\xi(s)} {}_{s\in S}, \tag{2}$$

where $\mu(s), \xi(s)$ and $\lambda(s) > 0$ is a continuous function. In such a case, the Z is still MSP [4].

C. Schlather Model

Reference [7] introduced one of the max-stable models so-called Schlather model. Let $Y(\cdot)$ is stationer process where $E\left[\max\{0, Y(s)\}\right] = 1$ and $\{U_j, j \geq 1\}$ is Poisson process with intensity measure $u^{-2}du$. The stationary MSP with Frechet margin unit defined in the following equation:

$$Z(s) := \max_{j\geq 1}\left(U_j Y_i(s)\right), \qquad s \in S, \tag{3}$$

where $Y_i(\cdot)$ is identically and independent replication from $Y(\cdot)$. Reference [7] proposed $Y_i(\cdot)$ as Gaussian process stationary with correlation function $\rho(h)$. The cdf of bivariate Schlather model is:

$$P_r\left[Z(y_1) \le z_1, Z(y_2) \le z_2\right] = F(z_1, z_2)$$

$$F(z_1, z_2) = \exp\left[-\frac{1}{2}\left(\frac{1}{z_1} + \frac{1}{z_2}\right)\left(1 + \sqrt{1 - 2(\rho(h)+1)\frac{z_1 z_2}{(z_1 + z_2)^2}}\right)\right], \tag{4}$$

where h is Euclidean distance between location 1 and location 2 with correlation function of $\rho\ (h)$ calculated using Cauchy model.

$$\rho(h) = c_1\left[1 + \left(\frac{h}{c_2}\right)^2\right]^{\nu}, \quad \nu > 0\ ,$$

where c_1, with $0 < c_1 \le 1$ is sill parameter and $c_2 > 0$ is range parameter.

D. Extremal Coefficient

In extreme value modeling using MSP, the measurement of extremal dependence is indispensable. Extremal coefficient describes characteristics of tail dependencies denoted as:

$$\theta(s_1 - s_2) = -z \log\left\{Z(s_1) \le z, Z(s_2) \le z\right\} \tag{5}$$

$$\theta(s_1 - s_2) = 1 + \sqrt{\frac{1 - \rho(s_1 - s_2)}{2}}$$

where $1 \le \theta(s_1 - s_2) \le 2$. If $\theta(s_1 - s_2) = 1$, then it informs full dependencies whereas if $\theta(s_1 - s_2) = 2$, then it shows independence [7].

E. Selecting the Best Model

In this work, the Takeuchi Information Criterion (TIC) will be employed to choose the best trend surface model formulated as:

$$\begin{aligned}\hat{\mu}(s) &= \beta_{\mu,0} + \beta_{\mu,1} lon(s) + \beta_{\mu,2} lat(s)\\ \hat{\sigma}(s) &= \beta_{\sigma,0} + \beta_{\sigma,1} lon(s) + \beta_{\sigma,2} lat(s)\\ \hat{\xi}(s) &= \beta_{\xi,0}\end{aligned} \tag{6}$$

The TIC is the development of Composite Likelihood Information Criterion proposed by [6]. The TIC function is given by:

$$TIC = -2\ell_p(\hat{\psi}) + 2tr\left\{H(\hat{\psi})^{-1} J(\hat{\psi})\right\} \tag{7}$$

where $H(\hat{\psi}) = -\dfrac{\partial^2 \log f(z_{ik}, z_{jk}; \hat{\psi})}{\partial\psi\partial\psi^T}$

$$J(\psi) = -\sum_{k=1}^{K} \frac{\partial \log f(z_{ik}, z_{jk}; \psi)}{\partial\psi} \frac{\partial \log f(z_{ik}, z_{jk}; \psi)}{\partial\psi^T}$$

and $i = 1,2,\ldots,m-1$, $j = 1,2,\ldots,m$, $\hat{\psi}$ is the estimator obtained from maximum pairwise likelihood.

III. EMPIRICAL RESULT

The data used in this study is cumulative rainfall intensity for each ten days in Ngawi region in period 1981-2011. First, identify the existence of heavy tail data and extreme value using the histogram as exhibited by Figure 3. The histograms show that the distribution is skew to the right with heavy tail.

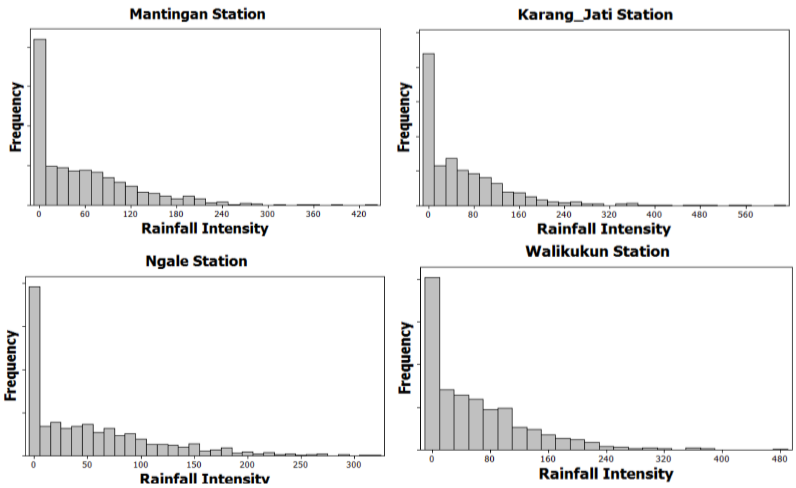

FIGURE 3. HISTROGRAM OF RAINFALL INTENSITIES FOR EACH LOCATION

Second, selecting extreme value from the original data using BM approach. Once the block period was defined, then the maximum value in each block is considered as extreme value. Figure 4 display the probability plot of extreme values in each location. I concluded that the samples of extreme rainfall with three months period (for each block) in all station in Ngawi region followed the GEV distribution.

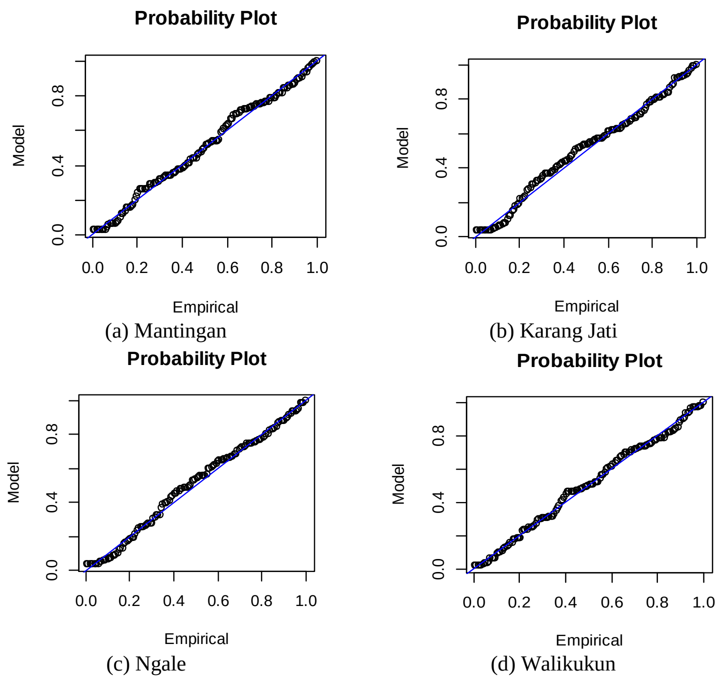

FIGURE 3. PROBABILITY PLOT OF EXTREME VALUES OBSERVATION

Third, obtain parameter sestimates $\hat{\mu}, \hat{\sigma}, \hat{\xi}$ for each location univariately using MLE continued with BFGS (Broyden, Fletcher, Goldfarb, Shanno) Quasi-Newton algorithm as optimization procedure. Table 1 summarized the parameters estimates.

TABEL 1. PARAMETERS ESTIMATES OF UNIVARIATE GEV DISTRIBUTION

Station	$\hat{\mu}$	$\hat{\sigma}$	$\hat{\xi}$
Mantingan	113.5034	79.04121	-0.15358
Karang Jati	113.2339	92.50203	-0.00933
Ngale	116.6084	80.1465	-0.27904
Walikukun	121.4399	81.73469	-0.11292

Fourth, transforming the extreme rainfall data obtained from BM approach into Frechet distribution using Z transformation as follows:

$$Z\left(s_i\right)=\left(1+\xi\,\frac{y-\mu}{\sigma}\right)^{1/\xi}$$

where y is extreme value sample, s_i shows the location and $\hat{\mu}, \hat{\sigma}, \hat{\xi}$ are GEV parameters obtained in step 3.

Fifth, to obtain parameter estimates (Smooth, Range, Nugget) for spatial dependence modeling using Schlachter model. In the beginning, counting spatial dependence with an extremal coefficient for each pair of location, see Table 2. Equation for extremal coefficient with Schlather model is:

$$\theta(s_i-s_j)=-z\log P\left\{Z(s_i)\le z, Z(s_j)\le z\right\}$$

$$\theta\left(s_i-s_j\right)=1+\sqrt{\frac{1-\rho\left(s_i-s_j\right)}{2}}$$

If $1\le\theta\left(s_1-s_2\right)\le 2$ then the data have spatial dependencies. Parameter estimates of spatial dependence using Schlather model is summarized in Table 3.

TABEL 2. EXTREMAL COEFFICIENT

Euclidean distance	Extremal coefficient
0.46874	1.310179
0.22158	1.295339
0.073479	1.316569
0.247165	1.294821
0.400665	1.310192
0.154637	1.236751

TABEL 3. PARAMETERS ESTIMATES OF SPATIAL DEPENDENCE

correlation function	nugget	range	smooth
Cauchy	0.219356	2.218379	10.03399

Sixth, obtain parameters estimates for GEV distribution using Maximum Pairwise Likelihood Estimation (MPLE) method followed by using BFGS Quasi-Newton. The GEV spatial model is given by:

$$GEV\left(\hat{\mu}(s), \hat{\sigma}(s), \hat{\xi}(s)\right)$$

where GEV parameter obtained from trend surface model combination, i.e.:

$$\hat{\mu}(s) = \hat{\beta}_{\mu,0} + \hat{\beta}_{\mu,1} lon(s) + \hat{\beta}_{\mu,2} lat(s)$$
$$\hat{\sigma}(s) = \hat{\beta}_{\sigma,0} + \hat{\beta}_{\sigma,1} lon(s) + \hat{\beta}_{\sigma,2} lat(s)$$
$$\hat{\xi}(s) = \hat{\beta}_{\xi,0}$$

The best model was selected based on TIC. The smallest TIC value is 2357.718 from the combination of trend surface models:

$$\hat{\mu}(s) = \hat{\beta}_{\mu,0} + \hat{\beta}_{\mu,2} lat(s) = 0.964676 + 0.001744\, lat(s)$$
$$\hat{\sigma}(s) = \hat{\beta}_{\sigma,0} + \hat{\beta}_{\sigma,2} lat(s) = 0.972590 + 0.004346\, lat(s)$$
$$\hat{\xi}(s) = \hat{\beta}_{\xi,0} = 1.079$$

The parameters of GEV spatial Schlather model in each station were reported in Table 4.

TABEL 4. PARAMETERS ESTIMATES OF GEV SPATIAL

Station	$\hat{\mu}$	$\hat{\sigma}$	$\hat{\xi}$
Mantingan	0.951842253	1.45569397	1.079
Karang Jati	0.951679014	1.45769009	1.079
Ngale	0.95176325	1.45663662	1.079
Walikukun	0.951774586	1.45596516	1.079

TABEL 5. PREDICTION OF RETURN LEVEL

Station	2 year (2013)	3 year (2014)
Mantingan	273.8945	304.6252
Karang Jati	298.2324	337.5429
Ngale	285.3738	320.5566
Walikukun	276.8673	318.2706

The results from last step were used to compute to predict return level of rainfall extreme for each station in Ngawi region. The period used in return level calculation is two years and three years ahead. The general equation for return level calculation is:

$$z_p(s) = \hat{\mu}(s) - \frac{\hat{\sigma}(s)}{\hat{\xi}(s)}\left(1 - \left[-\ln\left(1 - \frac{1}{T}\right)\right]^{-\xi(s)}\right).$$

where $T = 2\text{ year} \times 4\,(\text{number of block}) = 8$. The predictions of return level for two and three years were summarized in Table 5. In 2013, the predicted cumulative heaviest rainfall for ten days in Karang Jati Station is 298.2324 mm. The return level increased in 2014 become 337.5429 mm. As happened in Karang Jati, the prediction of return level for all station increased significantly from 2013 to 2014.

IV. CONCLUSION AND SUGGESTION

The empirical results indicated that extreme rainfall data in Ngawi followed univariate GEV distribution. The shape parameter estimates were always negative for each location in univariate analysis whereas they were positive constant in multivariate analysis, i.e. GEV spatial. In this study, the prediction value of return level showed that the highest rainfall intensity increase in last two years. Further research can consider more locations in order to obtain more meaningful results.

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M – 02

Bivariate Binary Probit Model Approach for Birth Attendance and Labor Participation in West Papua

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Abstract— The indicators used to determine the quality of the health services and the rate of public health in a region is including the Maternal Mortality Rate (MMR). One ways to reduce the maternal mortality rate in Indonesia is assisted the birth by trained health personnel and deliver at health care facilities. Extent of delivery assistance by health professionals nationwide in 2014 decreased by 2,2% from the year 2013 with the highest order is D.I. Yogyakarta and the lowest is West Papua. Selection of non-medical birth assistance is mostly done by women who do not work. That is because women who don't work haven't better access about health. This study aims to applying binary bivariate probit model to determine the factors that affect the birth attendance and labor participation. Source of data used in this research is the data of the National Socio Economic Survey (SUSENAS) in West Papua Province year 2014. Parameter estimation method used bivariate probit model is the Maximum Likelihood Estimation (MLE) with Newton Raphson iteration. The best model selection criterion based on the AIC (Akaike Information Criterion) generate information that mother's, area status, and age of mother have a significant effect on birth attendance and labor participation.

Keywords: *Birth Attendance, Labor Participation, Bivariate Binary Probit, MLE, AIC*

I. INTRODUCTION

One of the Millenium Development Goals (MDGs) goals is to improve maternal health, with the target of reducing maternal mortality by three-quarters between 1990 - 2015, as well as indicators for monitoring that the maternal mortality rate, the proportion of aid deliveries by skilled health personnel, and the contraceptive prevalence rate. Results based on data from Indonesia Health Profile 2014 show that birth attendance by health professionals in 2014 decreased 2,2% from 2013. The lowest coverage of births attended by trained health personnel is the province of West Papua was 44,73%. Selection of non-medical birth assistance is mostly done by women who do not work. That is because women who don't work have not access about health and health facilities [1]. Moreover, mothers who do not work and do not have health insurance tend to choose non-medical birth attendant with individual characteristics in rural areas.

Probit regression model is the model which uses to analyze dependent response variable in the form of qualitative with predictor variables in the form of quantitative or qualitative. Bivariate probit model uses two dichotomous variables as the response variable. Bivariate binary probit model has been carried out in many researches. Hamori and Chen (2010) used bivariate probit model to analyze of different between male and female formal employment in Urban China. Wahyudi (2014) used binary bivariate probit model that focuses on rural and urban poverty modelling with the poverty line approach in Bengkulu Province. Based on previous descriptions, this study will be applying binary bivariate probit model to determine the factors that affect the birth attendance and labor participation.

II. STATISTICAL METHODOLOGY

The statistical method is a procedure used in collecting, analysis presenting and interpretation of data. In this section, presented the framework of statistical method for estimating birth attendance probabilities of working mothers and do not work.

A. Bivariate Binary Probit Regression Model

Bivariate binary probit regression model is a model that consist of two response variables in the form of binary categorical data whereas the predictor variables in the form of discrete variables and continuous. This model has two qualitative response variables Y_1 and Y_2 are assumed from latent variable Y_1^* and Y_2^* with each of the response variables has two categories [2]. Therefore, bivariate binary probit model is represented as follows [3]:

$$y_1^* = \boldsymbol{\beta_1 X} + \varepsilon_1 \tag{1}$$

$$y_2^* = \boldsymbol{\beta_2 X} + \varepsilon_2 \tag{2}$$

where,

y_1^*, y_2^* : latent (not directly observed) dependent variables
β : vector of estimable parameters
X : vector of explanatory variables
$\varepsilon_1, \varepsilon_2$: disturbance terms assumed to be normally distributed with zero mean and variance of 1, and correlation of ρ.

The values for $y_1^*$and y_2^* are unobservable and related to the following binary dependent variables, on the basis of the following conditions:

$Y_1 = 1$, if $y_1^* > 0$; $Y_1 = 0$, if $y_1^* \leq 0$

and

$Y_2 = 1$, if $y_2^* > 0$; $Y_2 = 0$, if $y_2^* \leq 0$

B. Maximum Likelihood Estimation

The parameters of the bivariate binary probit model can be estimated by maximum likelihood estimation method. Due to the estimation parameters generated by bivariate binary probit model was not close formed, the solution is using a numerical method by Newton Raphson iteration [2]. The log-likelihood function is given by:

$$L(\beta_1, \beta_2, \rho) = \prod_{i=1}^{n} P(Y_{11i} = y_{11i}, Y_{10i} = y_{10i}, Y_{01i} = y_{01i}) \tag{3}$$

C. Simultaneous Test of Bivariate Binary Probit Model

The hypotheses used in the simultaneous test as follows:

H_0 : $\beta_{11} = \beta_{12} = \cdots = \beta_{1k}$ and $\beta_{21} = \beta_{22} = \cdots = \beta_{2k}$

H_1 : At least one $\beta_{ij} \neq 0$ for $i = 1,2$ and $j = 1,2, \ldots, k$

The test statistic for testing the parameters of a bivariate probit model simultaneously represented as follows [3]:

$$G^2 = 2\sum_{i=1}^{n}\left[y_{11i} \ln\left(\frac{\hat{p}_{2i} - \hat{p}_{01i}}{\hat{p}_{2i}^* - \hat{p}_{01i}^*}\right) + y_{10i} \ln\left(\frac{\hat{p}_{1i} - \hat{p}_{2i} + \hat{p}_{01i}}{\hat{p}_{1i}^* - \hat{p}_{2i}^* + \hat{p}_{01i}^*}\right) + y_{10i} \ln\left(\frac{\hat{p}_{01i}}{\hat{p}_{01i}^*}\right) + y_{00i} \ln\left(\frac{1 - \hat{p}_{1i} - \hat{p}_{01i}}{1 - \hat{p}_{1i}^* - \hat{p}_{01i}^*}\right)\right] \tag{4}$$

H_0 is rejected at significance level α if $G^2 > \chi^2_{df,\alpha}$.

D. Partial Test of Bivariate Binary Probit Model

The aims of this test is to see the effect of each predictor variable toward response variables Y_1 and Y_2. The hypothesis is as follows:

$H_0 : \beta_{kl} = 0$

$H_1 : \beta_{kl} \neq 0$ with $k = 1,2$ and $l = 1,2,\ldots,m$

The test statistic for testing the parameters of a bivariate probit model partially represented as follows [2],

$$G^2 = 2\sum_{i=1}^{n}\left[y_{11i} \ln\left(\frac{\hat{p}_{11i}}{\hat{p}_{11i}^{**}}\right) + y_{10i} \ln\left(\frac{\hat{p}_{10i}}{\hat{p}_{10i}^{**}}\right) + y_{10i} \ln\left(\frac{\hat{p}_{01i}}{\hat{p}_{01i}^{**}}\right) + y_{00i} \ln\left(\frac{\hat{p}_{00i}}{\hat{p}_{00i}^{**}}\right)\right] \quad (5)$$

At a significance level α, rejected H_0 if $G^2 > \chi^2_{1,\alpha}$.

E. Akaike Information Criterion (AIC)

The best model selection criterion for bivariate binary probit model based on the Akaike Information Criterion (AIC). AIC is a model of the goodness of fit criteria parameters estimated based on the maximum likelihood method [4]. Thus, the AIC value can be obtained as follows:

$$AIC = \frac{-2\ln L(M_p) + 2q}{n} \quad (6)$$

III. EMPIRICAL RESULT

In this section will be reviewed modelling results of bivariate binary probit model. Afterwards, the full model will be selection for get the best model using AIC method.

A. Descriptive Statistical

Source of data used in this research is the data of the National Socio Economic Survey (SUSENAS) in West Papua Province Year 2014 with the observation units of households is the children aged 0-5 years old by 1357 households. The data used as the response variable is last birth attendants and mothers work participation. The predictor variables used the mother's last education, area status, age of mother, and age of first marriage mother.

Based on Table 1, it can be known that the selection of non-medical birth attendant in the West Papua province is still relatively high, reaching 31.17%. Selection of non-medical birth attendance is mostly done by women who do not work.

TABEL 1. DESCRIPTIVE TABLE OF RESPONSE VARIABLE

		Labor Participation		**Count**
		Non-labor	Labor	
Birth Attendance	Non-medical	233 (17,17%)	190 (14,00%)	423 (31,17%)
	Medical	568 (41,86%)	366 (26,97%)	934 (68,83%)
Count		801 (59,03%)	556 (40,97%)	1357

In bivariate probit regression modeling, between the response variable must be dependent. To determine dependency between the variable birth attendants and labor participation of mothers it is necessary to do a test. Dependency test used is Chi-Square test [5]. The results of processing using

SPSS20 programs, Chi-Square values obtained by 3,954 higher than $\chi^1_{(0,05;1)}$= 3,84. This means that there is a relationship between birth attendants with the labor participation of mother.

B. Bivariate Binary Probit Modelling

Full modeling results for all variables with bivariate binary probit model represented as follows:

$$\hat{y}_1^* = -0{,}7264 + 0{,}451D_{1.1} + 1{,}1498D_{1.2} + 0{,}6942D_2 + 0{,}0072X_3 + 0{,}0114X_4$$

$$\hat{y}_2^* = 0{,}3218 - 0{,}384D_{1.1} + 0{,}1136D_{1.2} - 0{,}2315D_2 - 0{,}0166X_3 + 0{,}0085X_4$$

Furthermore, the created models be tested simultaneously and partially to determine the effect of predictor variables on the response variable. Simultaneous testing conducted to determine whether the predictor variables have a significant effect or not for the response variable. Based on the results of the processing of binary bivariate probit model using StataSE12 program obtained *Wald Chi-Square* (G^2) value 282,96 or *p-value* less than α= 0,05, so can be concluded H_0 rejected. This means that at least one significant predictor variables on the response variable.

On the other hand, to determine which variables that influence the response variable is necessary to do partial test. Partial testing conducted to determine the effect of each predictor or no significant effect on the response variable. Based on the test results of the bivariate probit model partially, in Table 2 show that the variables that significantly influence birth attendants variable is the mother's education (X_1) and the status area (X_2) (*p-value* <α = 0.05). In addition, Table 2 also represented that the variables mother education at elementary school or equivalent junior high school ($D_{1.1}$), the status area (X_2), and age of mother (X_3) significantly affects the labor participation of mothers (*p-value* <α = 0 , 05).

TABEL 2. *P-VALUE* RESULT OF THE BIVARIATE BINARY PROBIT MODEL (FULL MODEL)

Predictor Variable		Birth Attendance (Y_1)		Labor Participation (Y_2)	
		Std. Err.	*p-value*	*Std. Err.*	*p-value*
Mother's Education (X_1)	Elementary School or Junior High School or equivalent ($D_{1.1}$)	0,1010	0,000	0,1003	0,000
	Senior High School or College or equivalent ($D_{1.2}$)	0,1205	0,000	0,1110	0,3066
Area Status (X_2)	Urban (D_2)	0,0947	0,000	0,0805	0,004
Age of Mother (X_3)	-	0,0055	0,194	0,0055	0,002
First Marriage Age of Mother (X_4)	-	0,0100	0,257	0,0095	0,365

C. The Best Model Selection

In the complete modelling, it is known that all the predictor variables have not been significant to $\hat{y}_1^*$ or $\hat{y}_2^*$. Furthermore, it needs to do the best model selection using AIC method. By combining all possible models or as much as 2^p-1 with *p* number of predictor variables and the values of AIC are provided in Table 3.

TABEL 3. AIC VALUE BIVARIATE BINARY PROBIT MODEL

No.	Model	AIC	No.	Model	AIC
1.	X_1, X_2, X_3, X_4	3222,211	9.	X_2, X_3	3373,809
2.	X_1, X_2, X_3	**3220,437**	10.	X_2, X_4	3381,377
3.	X_1, X_2, X_4	3228,814	11.	X_3, X_4	3474,924
4.	X_1, X_3, X_4	3280,959	12.	X_1	3293,097
5.	X_2, X_3, X_4	3355,259	13.	X_2	3391,539
6.	X_1, X_2	3329,250	14.	X_3	3503,691
7.	X_1, X_3	3279,622	15.	X_4	3501,408
8.	X_1, X_4	3290,019			

Based on Table 3, it can be seen that the selection results of the best model with the smallest AIC value is a model which involves X1, X2 and X3. So the best bivariate binary probit model formed is as follows:

$$\hat{y}_1^* = -0{,}5984 + 0{,}4499D_{1.1} + 1{,}1787D_{1.2} + 0{,}6969D_2 + 0{,}0103X_3$$

$$\hat{y}_2^* = 0{,}416 - 0{,}384D_{1.1} + 0{,}1375D_{1.2} - 0{,}2297D_2 - 0{,}0142X_3$$

From the binary bivariate probit best models, then tested parameters simultaneously and partially. Based on the results of StataSE12 program obtained that either by testing simultaneously or partially, the variables X1, X2 and X3 significant effect on the response variable.

IV. CONCLUSION

This paper showed that there is a dependency between the response variable birth attendants and labor participation based on the results of Chi-Square Test. Modelling using a binary probit bivariate produce the best model for AIC value of 3220,437 with significant variable is the mother's education variable (X_1), the status area (X_2), and the age of mother (X_3).

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M – 03

Parameter Estimation and Hypothesis Testing on Bivariate Generalized Poisson Regression

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Abstract— Poisson regression is regression method used to analyze response variable which is discrete. Equality of mean and variance (equidispersion) are the assumption that must be fulfilled in this model. If assumption is violated, the conclusion would be not valid. Wrong assumption occurs if variance greater than mean and is often called (overdispersion). But if variance less than mean it is called (underdispersion). There is no data used with excessive zero value on the response variable, therefore this research uses Bivariate Generalized Poisson Regression. Parameter estimation of Bivariate Generalized Poisson Regression is done by using Maximum Likelihood Estimation (MLE).

Keywords: *overdispersi, underdispersi, bivariate generalized poisson regression, MLE*

I. INTRODUCTION

Regression analysis is statistical method which is often used in science. The aim of analysis is modeling the relationship between two variables, which consist of predictor variable and response variable. In general, regression analysis is used in response variable which is continuous, but sometime response variable is discrete. Type of response variable is discrete which count data is non-negative that declare a lot of events in interval time, space or void volume. Data from an event would follow the Poisson distribution if such events are rare in a large sample[1]. This modeling is called Poisson Regression. There is assumption that must be met, mean and variance of response variable should be the same [6]. If assumption is violated, the conclusion would be not valid. Assuming violation occurs if variance is greater than mean is called overdispersion and if variance is less than mean is called underdispersion. Bivariate Poisson regression is used in data that have two response variables in data count with a high correlation.

II. LITERATURE

A. Bivariate Poisson Regression

Random variables Y_1, Y_2 is jointly bivariate Poisson distribution and according to [5] joint probability function :

$$f(y_1, y_2) = \begin{cases} e^{-(\mu_1+\mu_2+\mu_0)} \displaystyle\sum_{k=0}^{\min(y_1,y_2)} \frac{\mu_1^{\,y_1-k}\mu_2^{\,y_2-k}\mu_0^{\,k}}{(y_1-k)!(y_2-k)!k!} & ,(y_1,y_2)=0,1,2,\ldots \\ 0 & ,(y_1,y_2) \text{ yang lain} \end{cases} \quad (1)$$

Bivariate poisson regression model can be written

$$(Y_{1i}, Y_{2i}) \sim PB(\mu_{1i}, \mu_{2i}, \mu_0)$$
$$\mu_{ji} + \mu_0 = e^{x_i^T \beta_j};\ j = 1,2 \quad (2)$$

Estimation method is used on Bivariate Poisson Regression is Maximum Likelihood Estimation (MLE) [4]. The method for calculating statistic test in parameter test is using Maximum Likelihood Ratio Test (MLRT) :

$$D(\hat{\beta}) = -2\ln\left(\frac{L(\hat{\omega})}{L(\hat{\Omega})}\right) = 2\left(\ln L(\hat{\Omega}) - \ln L(\hat{\omega})\right) \tag{3}$$

where

$L(\hat{\Omega})$: Maximum Likelihood for complete model with predictor variable

$L(\hat{\omega})$: Maximum Likelihood for simple model without predictor variable

B. Generalized Poisson Regression

Generalized Poisson Regression is used to modeling overdispersion or underdispersion [2]. According to [3], Generalized Poisson Distribution has probability function:

$$f(y_i, \mu_i, \alpha) = \left(\frac{\mu_i}{1+\alpha\mu_i}\right)^{y_i} \frac{(1+\alpha y_i)^{y_i-1}}{y!} \exp\left(\frac{-\mu_i(1+\alpha y_i)}{1+\alpha\mu_i}\right) \tag{4}$$

$$\mu_i = \mu_i(x_i) = \exp(\mathbf{x_i}\boldsymbol{\beta})$$

Generalized Poisson Regression model have same form as Poisson Regression model:

$$\mu_i = \exp(\mathbf{x_i^T}\boldsymbol{\beta}) = \exp(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + ... + \beta_k x_{ki}) \tag{5}$$

Estimation method is used on Generalized Poisson Regression is Maximum Likelihood Estimation (MLE). Method to compute statistic test on parameter test is using Maximum Likelihood Ratio Test (MLRT):

$$D(\hat{\beta}) = -2\ln\left(\frac{L(\hat{\omega})}{L(\hat{\Omega})}\right) = 2\left(\ln L(\hat{\Omega}) - \ln L(\hat{\omega})\right) \tag{6}$$

where

$L(\hat{\Omega})$: Maximum Likelihood for complete model with predictor variables

$L(\hat{\omega})$: Maximum Likelihood for simple model without predictor variables

C. Bivariate Generalized Poisson Regression

According to [7] for example N_1, N_2, N_3 are random variable and independent so Generalized Poisson distribution $Y_1 = N_1 + N_3$ and $Y_2 = N_2 + N_3$ Consul dan Shoukri (1985) in Vernic (1997) explained that $X \sim GDP(\mu, \alpha)$ then the probability function of Bivariate Generalized Poisson :

$$f(y_{1i}, y_{2i}) = \left\{ \begin{array}{l} \mu_{1i}\mu_{2i}\mu_0 \exp\{-(\mu_{1i}+\mu_{2i}+\mu_0) - y_{1i}\alpha_1 - y_{2i}\alpha_2\} \\ \sum\limits_{k=0}^{\min(y_1,y_2)} \frac{1}{(y_{1i}-k)!(y_{2i}-k)!k!}(\mu_{1i}+(y_{1i}-k)\alpha_1)^{y_1-k-1})(\mu_{2i}+(y_{2i}-k)\alpha_2)^{y_2-k-1})(\mu_0+k\alpha_0)^{k-1}) \\ \exp\{k(\alpha_1+\alpha_2-\alpha_0)\} \end{array} \right\}$$

Model of Bivariate Generalized Poisson Regression is

$$\mu_{ji} = \exp(\mathbf{x_i^T}\boldsymbol{\beta_j}) = \exp(\beta_{j0} + \beta_{j1} x_{1i} + \beta_{j2} x_{2i} + ... + \beta_{jk} x_{ki})$$

Parameter estimation of Bivariate Generalized Poisson Regression is done by using Maximum Likelihood Estimation (MLE). The method for calculating statistic test is using Maximum Likelihood Ratio Test (MLRT):

$$D(\hat{\beta}) = -2\ln\left(\frac{L(\hat{\omega})}{L(\hat{\Omega})}\right) = 2\left(\ln L(\hat{\Omega}) - \ln L(\hat{\omega})\right) \tag{9}$$

where

$L(\hat{\Omega})$: Maximum Likelihood for complete model with predictor variables

$L(\hat{\omega})$: Maximum Likelihood for simple model without predictor variables

III. METHOD

Steps to get parameter estimator Bivariate Generalized Poisson Regression model is (1) Forming the likelihood function of Bivariate Generalized Poisson Regression model; (2) Forming function ln likelihood of Bivariate Generalized Poisson Regression model; (3) Transforming ln likelihood function; (4) Looking first partial derivative of ln likelihood function; (5) Looking for second partial derivatives of ln likelihood function; (6) Getting parameter estimator with Newton Raphson iteration; (7) Hypotheses test simultaneous is using MLTR and partial test.

IV. RESULT AND DISCUSSION

Parameter estimation method Bivariate Generalized Poisson Regression is a Maximum Likelihood Estimation (MLE) with probability function:

$$f\left(y_{1i}, y_{2i}\right) = \left\{ \begin{array}{l} \mu_0 \mu_{1i} \mu_{2i} \exp\left\{-\left(\mu_0 + \mu_{1i} + \mu_{2i}\right) - y_{1i}\alpha_1 - y_{2i}\alpha_2\right\} \sum\limits_{k=0}^{\min(y_1, y_2)} \dfrac{(\mu_{1i} + (y_{1i}-k)\alpha_1)^{y_{1i}-k-1}}{(y_{1i}-k)!} \times \\ \dfrac{(\mu_{2i} + (y_{2i}-k)\alpha_2)^{y_{2i}-k-1}}{(y_{2i}-k)!} \times \dfrac{(\mu_0 + k\alpha_0)^{k-1}}{k!} \left(\exp k\left(\alpha_1 + \alpha_2 - \alpha_0\right)\right) \end{array} \right\}$$

the function ln likelihood of Bivariate Generalized Poisson:

$$Q = \ln L\left(\mu_0 \boldsymbol{\beta}_1 \boldsymbol{\beta}_2 \alpha_1 \alpha_2\right) = \left\{ \begin{array}{l} \sum\limits_{i=1}^{n} \ln \mu_0 + \sum\limits_{i=1}^{n} \ln\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_1} - \mu_0\right) + \sum\limits_{i=1}^{n} \ln\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_2} - \mu_0\right) - n\mu_0 + \\ \sum\limits_{i=1}^{n}\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_1} - \mu_0\right) + \sum\limits_{i=1}^{n}\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_2} - \mu_0\right) - \sum\limits_{i=1}^{n} y_{1i}\alpha_1 - \sum\limits_{i=1}^{n} y_{2i}\alpha_2 + \sum\limits_{i=1}^{n} \ln W_i \end{array} \right\}$$

the first derivative of $\ln L(\mu_0 \boldsymbol{\beta}_1^T \boldsymbol{\beta}_2^T \alpha_1 \alpha_2)$ to μ_0 is

$$\frac{\partial Q}{\partial \mu_0} = \frac{-n}{\mu_0} - n - 2 + \sum_{i=1}^{n} \sum_{k=0}^{\min(y_1 y_2)} \left\{ \frac{-\left(y_{1i}-k-1\right)}{\left(\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_1} - \mu_0\right) + \left(y_{1i}-k\right)\alpha_1\right)} + \left(\frac{-\left(y_{2i}-k-1\right)}{\left(\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_2} - \mu_0\right) + \left(y_{2i}-k\right)\alpha_2\right)} + \frac{k-1}{\left(\mu_0 + k\alpha_0\right)} \right) \right\} \tag{10}$$

the first derivative of $\ln L(\mu_0 \boldsymbol{\beta}_1^T \boldsymbol{\beta}_2^T \alpha_1 \alpha_2)$ to $\boldsymbol{\beta}_1$ is

$$\frac{\partial Q}{\partial \boldsymbol{\beta}_1} = \left\{ \begin{array}{l} \sum\limits_{i=1}^{n} \dfrac{1}{e^{\mathbf{x}_i^T \boldsymbol{\beta}_1}} \left(\exp\left(\mathbf{x}_i^T \boldsymbol{\beta}_1\right) \mathbf{x}_i\right) + \sum\limits_{i=1}^{n}\left(\exp\left(\mathbf{x}_i^T \boldsymbol{\beta}_1\right) \mathbf{x}_i\right) + \\ \sum\limits_{i=1}^{n} \sum\limits_{k=0}^{\min(y_1 y_2)} \left(y_{1i}-k-1\right)\left(\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_1} - \mu_0\right) + \left(y_{1i}-k\right)\alpha_1\right)^{y_{1i}-k-1} \left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_1}\right) \mathbf{x}_i \end{array} \right\} \tag{11}$$

the first derivative of $\ln L(\mu_0 \boldsymbol{\beta}_1^T \boldsymbol{\beta}_2^T \alpha_1 \alpha_2)$ to $\boldsymbol{\beta}_2$ is

$$\frac{\partial Q}{\partial \boldsymbol{\beta}_2} = \left\{ \begin{array}{l} \sum\limits_{i=1}^{n} \dfrac{1}{e^{\mathbf{x}_i^T \boldsymbol{\beta}_2}} \left(\exp\left(\mathbf{x}_i^T \boldsymbol{\beta}_2\right) \mathbf{x}_i\right) + \left(\exp\left(\mathbf{x}_i^T \boldsymbol{\beta}_2\right) \mathbf{x}_i\right) + \sum\limits_{i=1}^{n} \sum\limits_{k=0}^{\min(y_1 y_2)} \left(y_{2i}-k-1\right) \\ \left(\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_2} - \mu_0\right) + \left(y_{2i}-k\right)\alpha_2\right)^{y_{2i}-k-1} \left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_2}\right) \mathbf{x}_i \end{array} \right\} \tag{12}$$

the first derivative of $\ln L(\mu_0 \boldsymbol{\beta}_1^T \boldsymbol{\beta}_2^T \alpha_1 \alpha_2)$ to α_1 is

$$\frac{\partial Q}{\partial \alpha_1} = -\sum_{i=1}^{n} y_{1i} + \sum_{i=1}^{n} \sum_{k=0}^{\min(y_1 y_2)} \left(\frac{\left(y_{1i}-k-1\right)\left(y_{1i}-k\right)}{\left(\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_1} - \mu_0\right) + \left(y_{1i}-k\right)\alpha_1\right)^{y_{1i}-k}} + 1 \right) \tag{13}$$

the first derivative of $\ln L(\mu_0 \boldsymbol{\beta}_1^T \boldsymbol{\beta}_2^T \alpha_1 \alpha_2)$ to α_2 is

$$\frac{\partial Q}{\partial \alpha_2} = -\sum_{i=1}^{n} y_{2i} + \sum_{i=1}^{n} \sum_{k=0}^{\min(y_1 y_2)} \left(y_{2i}-k\right)\left(y_{2i}-k-1\right)\left(\left(e^{\mathbf{x}_i^T \boldsymbol{\beta}_2} - \mu_0\right) + \left(y_{2i}-k\right)\alpha_2\right)^{y_{2i}-k-1} \quad (14)$$

the first derivative does not close form so that to solve the equation is using Newton Rahpson iteration with equation (15) as follow

$$\hat{\boldsymbol{\theta}}_{(m+1)} = \hat{\boldsymbol{\theta}}_{(m)} - \mathbf{H}^{-1}\left(\hat{\boldsymbol{\theta}}_{(m)}\right)\mathbf{g}\left(\hat{\boldsymbol{\theta}}_{(m)}\right) \quad (15)$$

$$\boldsymbol{\theta} = \left(\mu_0, \boldsymbol{\beta}_1^T, \boldsymbol{\beta}_2^T, \alpha_1, \alpha_2\right)^T$$

$$\mathbf{g}^T\left(\boldsymbol{\theta}_{(m)}\right)_{(k+1)} = \left(\frac{\partial \ln L(\boldsymbol{\theta})}{\partial \mu_0}, \frac{\partial \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_1}, \frac{\partial \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_2}, \frac{\partial \ln L(\boldsymbol{\theta})}{\partial \alpha_1}, \frac{\partial \ln L(\boldsymbol{\theta})}{\partial \alpha_2}\right)_{\boldsymbol{\theta}=\boldsymbol{\theta}_{(m)}} \quad (16)$$

$$\boldsymbol{H}(\boldsymbol{\theta}_{(m)})_{(k+1)(k+1)} = \begin{bmatrix} \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \mu_0^2} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \mu_0 \partial \boldsymbol{\beta}_1^T} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \mu_0 \partial \boldsymbol{\beta}_2^T} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \mu_0 \partial \alpha_1} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \mu_0 \partial \alpha_2} \\ & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_1^T \partial \boldsymbol{\beta}_1} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_1^T \partial \boldsymbol{\beta}_2} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_1^T \partial \alpha_1} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_1^T \partial \alpha_2} \\ & & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_2^T \partial \boldsymbol{\beta}_2} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_2^T \partial \alpha_1} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \boldsymbol{\beta}_2^T \partial \alpha_2} \\ & & & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \alpha_1 \partial \alpha_1^T} & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \alpha_1 \partial \alpha_2} \\ & \textit{Simetris} & & & \frac{\partial^2 \ln L(\boldsymbol{\theta})}{\partial \alpha_2 \partial \alpha_2^T} \end{bmatrix} \quad (17)$$

Hessian matrix is matrix that contain second derivative of function $\ln L(Q)$ to the parameter $\left(\mu_0, \boldsymbol{\beta}_1^T, \boldsymbol{\beta}_2^T, \alpha_1, \alpha_2\right)$

Parameter estimation steps with Newton-Raphson iteration is

1. Determining the initial value of parameter
2. Forming vector $\mathbf{g}(\boldsymbol{\theta})$ by substituting equation (10), (11), (12), (13) and (14) into the equation (15)
3. Hessian matrix forming by substitute the resulting equation of second derivative into (17).
4. Inserting values into $\hat{\boldsymbol{\theta}}_{(0)}$ vector elements $\mathbf{g}$ and matrix $\mathbf{H}$
5. Starting from $m = 0$ iterating at the equation (15) . Value $\hat{\boldsymbol{\theta}}_{(m)}$ is a collection of parameter estimator which convergent the current iteration m.
6. If have not gotten parameter estimation are convergent, then proceeded to step 5 to $m = m+1$ iteration. Iteration will stop if the value of $\left\|\hat{\boldsymbol{\theta}}_{(m+1)} - \hat{\boldsymbol{\theta}}_{(m)}\right\| \le \varepsilon$.

Hypothesis test is done in two parts that is

i. Hypothesis testing simultaneous is using MLTR with hypotheses

Parameter $\boldsymbol{\beta}$

$H_0 : \beta_{j1} = \beta_{j2} = ... = \beta_{jk} = 0; j = 1, 2$

H_1 : at least one $\beta_{jk} \ne 0;\ j = 1, 2$ with $l = 1, 2, ..., k$

Parameter α

$H_0 : \alpha_1 = \alpha_2 = 0;$

H_1 : at least one $\alpha_j \neq 0;\ j = 1, 2$

Statistical test :

$$D(\hat{\beta}) = -2\ln\left(\frac{L(\hat{\omega})}{L(\hat{\Omega})}\right) = 2\left(\ln L(\hat{\Omega}) - \ln L(\hat{\omega})\right)$$

$L(\hat{\Omega})$:Maximum Likelihood for complete model with predictor variables and $L(\hat{\omega})$: Maximum Likelihood for simple model without predictor variables. The rejection region H_0 if $D(\beta) > \chi^2_{(\alpha,v)}$

ii. Hypothesis testing partial is using Z-test with hypothesis

Parameter β

$H_0 : \beta_{jl} = 0$

$H_1 : \beta_{jl} \neq 0$ with $j = 1, 2$ and $l = 1, 2, ..., k$

Statistical test :

$$Z_{cal} = \frac{\hat{\beta}_{jl}}{SE(\hat{\beta}_{jl})}$$

The rejection region H_0 if $|Z_{cal}| > Z_{(\alpha,v)}$

Parameter α

$H_0 : \alpha_j = 0$

$H_1 : \alpha_j \neq 0$ with $j = 1, 2$

Statistical test :

$$Z_{cal} = \frac{\hat{\alpha}_j}{SE(\hat{\alpha}_j)}$$

The rejection region H_0 if $|Z_{cal}| > Z_{(\alpha,v)}$

RESULT

Parameter estimation model on Bivariate Generalized Poisson Regression is using Maximum Likelihood (ML). The results obtained from parameter estimation does not close form that needs to be done by Newton Raphson iteration. On hypothesis test is using Maximum Likelihood Ratio Test (MLTR) by comparing the value of the likelihood under H_0 and likelihood under population. Hypothesis test is done in two parts simultaneous and partial.

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M – 04

Scour Analysis at Seawall in Salurang, Sangihe Islands Regency, North Sulawesi

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Abstract. Sangihe Islands Regency is one of the outermost regions of the unitary Republic of Indonesia. The area is dominated by coastal areas. Thus, many coastal structures protection built to guard the coastal areas from the threat of big waves. Local scour is the erosion of the basis on a particular part of a building coast. If it occurs continously, it could lead to instability of the structure or structural failure. The research takes a case study on scouring at Seawall in Salurang, Sangihe Islands Regency, North Sulawesi. This study aims to determine dominant factor of scouring and predict the maximum scour depth and scour length at seawall by using Van Rijn method (2013) which is one method of numerical calculation. The method is expected to provide the right solution for handling a scouring at coastal structures in this area. The right method to predict maximum scour depth in Salurang, Sangihe Islands regency is the scour method near the tip of wall-type or rubble-mound-type structure due to waves (plus weak currents <0.3 m/s). Scour due to combination of waves and currents. The maximum scour depth value is 0.36 m and the scour length is 3.6 m. The local government can protect the coastal structure by providing stone mound at the toe based on the calculation of the maximum scour depth.

Keywords: *Maximum scour depth, seawall, Van Rijn method, Sangihe Islands Regency*

I. INTRODUCTION

Sangihe Islands Regency is an integral part of the capital city of North Sulawesi Tahuna. Located approximately 142 Nautical Miles from the capital of North Sulawesi, Manado, located between 2 ° 4'13 "- 4 ° 44 '22" North Latitude and 125 ° 9' 28 "- 125 ° 56 '57" East, located between the Sulawesi islands and Mindanao (Republic of the Philippines), so the Sangihe Islands Regency can be categorized as "Frontier". The total area of Sangihe Islands Regency amounted to 736.98 km2 [1]. As a coastal region, this region, many built of coastal protection structures to prevent the influence of big waves. Seawall was built in Salurang village in 2003 with a length of 471.2 m, a width of 1 m and a height of 4 m. However, the scouring which caused by damage to some parts of the structure will occur in the local seawall few years later.

Sumer, et al. (2001) has conducted research on scouring the various types of coastal structures and scour depth development model with physical and numerical modeling [5]. El-bisy (2006) has studied on the seawalls and predict scour using neural network models (ANNs) [3]. This study will predict the maximum scour depth on the seawall in Kampung Salurang using Van Rijn method (2013) [9]. Thus, is expected to provide the right solution for protection against scouring. And, the proper handling of coastal protection.

Scour will occur anywhere the hydrodynamic shear stresses on the bottom are high enough to initiate sediment transport. Clear water scour occurs when bottom shear stresses are high only in a localized portion of the bed; outside the local region sediment is not moving. This occurs mostly in uniform, steady flow situations. In live bed scour, bottom shear stresses over the entire bed exceed the level for incipient motion with locally higher shear stresses where greater scour occurs. An equilibrium is reached when the volume of sediment being removed from the scour hole is exactly equal to sediment being deposited in its place. Understanding the physical processes involved in scour is difficult because the shear stresses responsible for scour are developed by waves, currents, or combined waves and currents, that usually are heavily influenced by the presence of a coastal structure. Because of the distinct influence coastal structures exert on the hydrodynamics, structural aspects such as geometry, location, and physical characteristics (roughness, permeability, etc.) impact the scour process. Therefore, modifying some physical characteristic of a structure may reduce scour potential. [2]

II. METHODS

A. Refraction Analysis

To get a value of wave height at structure, it is necessary to analyze the refraction, by some calculations below.

$L_0 = 1.56T^2$ (m)	[wave length at deep water]	(1)
$C_0 = L_0/T$ (m/s)	[celerity at deep water]	(2)
$L = d/(\frac{d}{L})$ (m)	[wave length]	(3)
$C = L/T$ (m)	[celerity]	(4)
$\sin a = (\frac{C}{C_0}) \sin a_0$	[a = incident wave angle]	(5)
$K_r = (\cos a_0 \,/\, \cos a)^{0.5}$	[refraction coefficient]	(6)
$K_s = (n_0 \times L_0/n \times L)^{0.5}$	[shoaling coefficient]	(7)
$H = K_s \times K_r \times H_0$ (m)	[wave height] [10]	(8)

B. Van Rijn Method

To predict maximum scour depth, used the formulas below.

#1 Scour near toe of wall-type or rubble-mound-type structures due to waves

- Scour's formula for Wall-type structure
  a. SPM, 1984 $d_{s,max} = SF.h_{toe}$ (9)
  b. Fowler, 1992
  $\frac{h_{toe}}{L_0} < 0{,}06 \rightarrow d_{s,max} = SF\left(11{,}4\left(\frac{h_0}{L_0}\right) + 0{,}54\right).h_{s,off}$ (10)
  $\frac{h_{toe}}{L_0} > 0{,}06 \rightarrow d_{s,max} = SF.h_{s,off}$ (11)
  c. SATO, 1968
  $h_0 < 9 \rightarrow d_{s,max} = SF(-0{,}2.h_0 + 1{,}9)$ (12)
  $h_0 > 9 \rightarrow d_{s,max} = 0{,}1.SF.h_0$ (13)
  d. Yokoyama, 2002
  $\frac{H_s}{h_{toe}} > 0 \rightarrow d_{s,max} = SF\left(2.\frac{H_s}{h_{toe}} - 0{,}5\right).h_{toe}$ (14)
  $\frac{H_s}{h_{toe}} < 0 \rightarrow d_{s,max} = 0{,}1.SF.h_{toe}$ (15)
  e. Xie, 1981
  $\frac{h_{toe}}{L_w} < 0{,}15 \rightarrow d_{s,max} = SF\left(-64.\frac{h_{toe}}{L_w} + 1{,}2\right)h_{toe}$ (16)
  $\frac{H_s}{h_{toe}} > 0{,}15 \rightarrow d_{s,max} = 0{,}25.SF.h_{toe}$ (17)
- Scour's formula for Rubble-mound-type structure

Scour length is assumed to be 0,7 × scour depth of wall – type structures.

#2 Scour near tip of wall-type and rubble-mound type structures due to waves (plus weak current < 0.3 m/s)

- Scour's formula for Wall-type structure

Sumer, 1997

Maximum value of: $KC\ Number < 10 \rightarrow d_{s,max} = 0{,}05.SF.\ KC\ Number.B$ (18)

$KC\ Number > 10 \rightarrow d_{s,max} = 0{,}5.SF.B;$ (19)

and $d_{s,max} = 0{,}2.h_{toe}$ (20)

- Scour's formula for Rubble-mound-type structure

a. Sumer, 1997
Maximum value between

$$T_p\left(\frac{9{,}81.h_{toe}}{h_0}\right)^{0,5} < 15 \rightarrow d_{s,max} = 0{,}03.SF.\left(T_p\left(\frac{9{,}81.h_{toe}}{h_0}\right)^{0,5}\right) \quad (21)$$

$$T_p\left(\frac{9{,}81.h_{toe}}{h_0}\right)^{0,5} > 15 \rightarrow d_{s,max} = 0{,}5.SF.h_{toe} \quad (22)$$

And, $d_{s,max} = 0{,}15.h_{toe}$ (23)

b. Field Data Japan, USA

$$h_0 < 15 \rightarrow d_{s,max} = SF.(-0{,}033.h_0 + 0{,}7).h_0 \quad (24)$$

$$h_0 > 15 \rightarrow d_{s,max} = 3.SF \quad (25)$$

$$d_{s,max} = 0{,}15.h_{toe} \quad (26)$$

#3 Scour near tip of wall-type and rubble-mound type structures due to relatively strong current (> 0.3 m/s) plus waves

$$h_0 < 14 \rightarrow d_{s,max} = SF \times (-0.25 \times h_0 + 4) \times h_0 \quad (27)$$

$$h_0 > 14 \rightarrow d_{s,max} = SF \times 7 \quad (28)$$

Generally, for scour length = 10 *x* Scour depth (29)

Where h_0 = depth at toe exclude scour, $d_{s,max}$ = maximum scour depth, SF = safety factor, T_p = peak wave period, h_{toe} = local wave height at toe, $KC\ Number$ = Keulegan-Carpenter Number, B = width of structure, L_w = wave length, H_s = significant wave height, $h_{s,off}$ = offshore significant wave height. And the mathematical formula for computing correlation coefficient = r is:

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2}\sqrt{n(\sum y^2) - (\sum y)^2}}, \quad (30)$$

where n is the number of pairs of data. The value of r is that $-1 \leq r \leq 1$. The $+$ and – signs are used for positive linear correlations and negative linear correlations, respectively. The coefficient of determination, r^2 or R^2, is useful because it gives the proportion of the variance (fluctuation) of one variable that is predictable from the other variable. The coefficient of determination is the ratio of the explained variation to the total variation. The coefficient of determination is such that $0 \leq r^2 \leq 1$, and denotes the strength of the linear association between x and y. The coefficient of determination represents the percent of the data that is closest to the line of best fit.

III. RESULTS AND DISCUSSION

The results of measurement and prediction for the maximum scour depth were shown in Tables 1-4. The comparison was given in Figure 1-3.

- Results of Measurement

TABEL 1. SCOUR DEPTH BY MEASUREMENT

h_0	Scour depth maximum = $d_{s,max}$ (m)	Scour Length (m)
1	0.6	6
1.79	0.64	6.4
1.95	0.37	3.7

- Results of Prediction

a. Scour near toe of wall-type or rubble mound-type structure due to waves

TABEL 2. MAXIMUM SCOUR DEPTH DUE TO WAVES

h_0	Scour depth maximum = $d_{s,max}$ (m)	Scour Length (m)
1	1.05	10.5
1.79	1.27	12.7
1.95	1.31	13.1

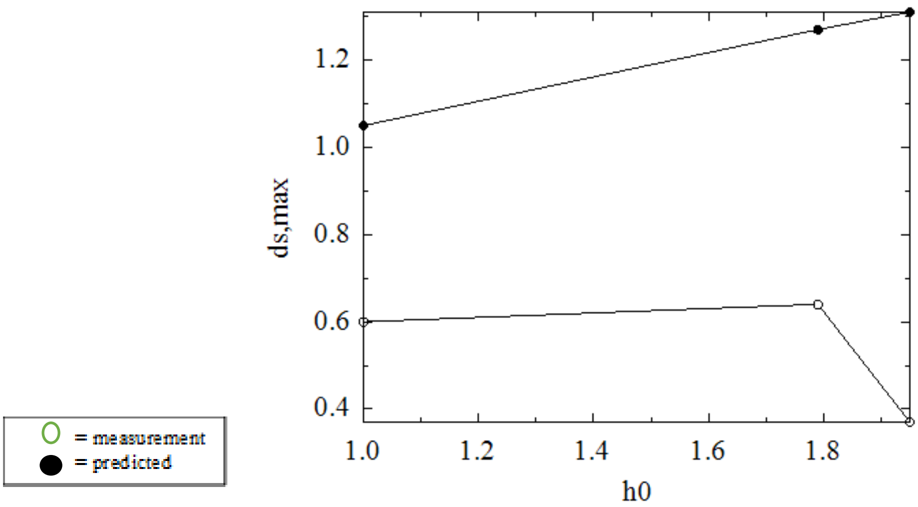

FIGURE 1. COMPARISON BETWEEN PREDICTION AND MEASUREMENT DUE TO WAVES

Based on the comparison between measurement and prediction have a coefficient correlation = r = 0.4. And $r^2 = 0.16$. It means that the prediction not accurately because the value of r^2 closest to 0.

b. Scour near tip of wall-type or rubble-mound-type structure due to waves (plus weak currents <0.3 m/s)

TABEL 3. MAXIMUM SCOUR DEPTH DUE TO WAVES PLUS WEAK CURRENT

h_0	Scour depth maximum = $d_{s,max}$ (m)	Scour Length (m)
1	0.3	3
1.79	0.36	3.6
1.95	0.35	3.5

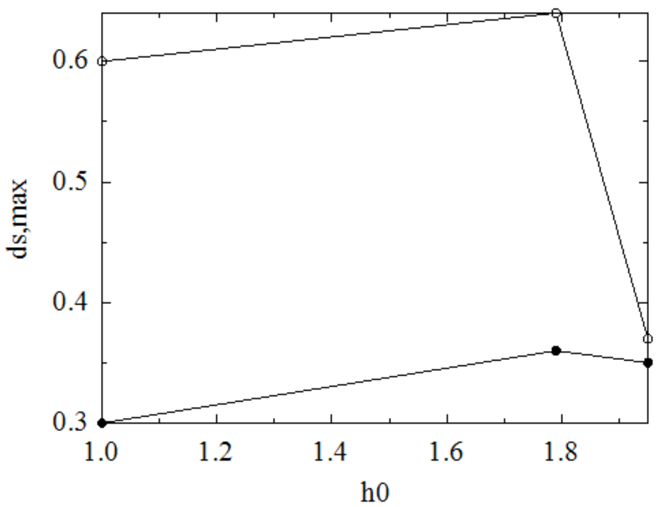

FIGURE 2. COMPARISON BETWEEN PREDICTION AND MEASUREMENT DUE TO WAVES PLUS WEAK CURRENT

Based on the comparison between prediction and measurement have a coefficient correlation r = 0.9. And $r^2 = 0.81$. It means that the prediction very accurately because the value of r^2 closest to 1.

c. Scour near tip of wall-type or rubble-mound-type structure due to relatively strong current (>0.3 m/s) plus waves.

TABEL 4. MAXIMUM SCOUR DEPTH DUE TO WAVES PLUS STRONG CURRENT

h_0	Scour depth maximum = $d_{s,max}$ (m)	Scour Length (m)
1	3.75	37.5
1.79	6.36	63.6
1.95	6.85	68.5

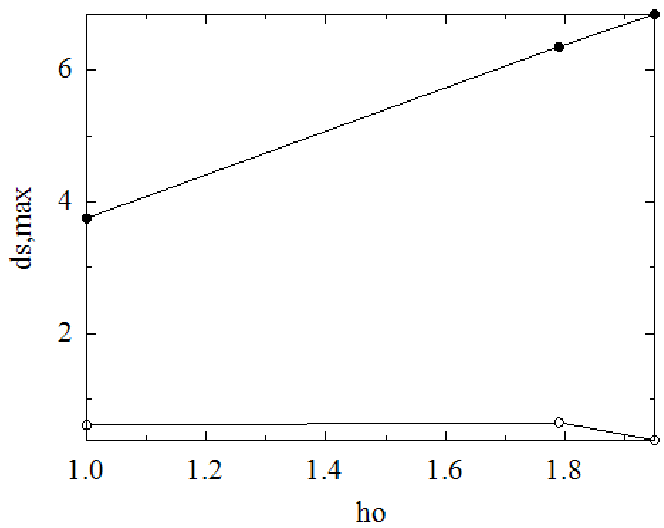

FIGURE 3. COMPARISON BETWEEN PREDICTED AND MEASUREMENT DUE TO WAVES PLUS STRONG CURRENT

Based on the comparison between prediction and measurement have a coefficient correlation r = 0.4. And $r^2 = 0.16$. It means that the prediction not accurately because the value of r^2 closest to 0.

From the results of comparison above, it can be seen that r^2 closest to 1 was on scour method calculation near the tip of wall-type or rubble-mound-type structure due to waves (plus weak currents <0.3 m/s). Scour due to combination of waves and currents. Thus, it can be said that the right method to be used in the calculation of scouring in the Salurang village, Sangihe Islands Regency is a scour method calculation near the tip of wall-type or rubble-mound-type structure due to waves (plus weak currents <0.3 m / s) with a maximum scour depth is 0.36 m and scour length is 3.6 m.

IV. CONCLUSION

The right method to predict maximum scour depth in Salurang, Sangihe Islands regency is the scour method near the tip of wall-type or rubble-mound-type structure due to waves (plus weak currents <0.3 m/s). Scour due to combination of waves and currents. The maximum scour depth value is 0.36 m and the scour length is 3.6 m. The local government can protect the coastal structure by providing stone mound at the toe based on the calculation of the maximum scour depth.

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M – 05

Longitudinal Tobit Regression

Modelling Stroke Patients With Trauma/Injury HeadTrauma

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***Abstract*—** Stroke is a major health problem for modern society. In the case of patients with stroke, a stroke patients often experience trauma / head injury due to falls in the bathroom, fell on the stairs or after waking. One way to determine the severity of head injuries in stroke patients is used of medical records Glasgow Coma Scale (GCS). But the scoring system at GCS alone sometimes has problems, such as pain medications under investigation and response variables measured on the visual analog, some patients will be reported "no pain" after a certain time. They could not say a lesser degree or higher from a sense of "no pain". To solve it, scoring at GCS will be given sensor at a certain value. Medical records on the severity of the trauma / injury done repeatedly over time. Time is very important and in the measurement of an event expected to be recorded properly. One approach that can be performed on longitudinal data which has a sensor point is to approach tobit longitudinal regression method. The response variable is the score on the Glasgow Coma Scale. The predictor variables having a significant effect is blood pressure (X_1), body temperature (X_2) and pulse (X_3).

Keywords: *Stroke, Longitudinal Tobit, Glasgow Coma Scale*

I. INTRODUCTION

Stroke is a major health problem for our modern society. Today, sroke increasingly becoming a serious malash facing almost all over the world. That is because the sudden stroke can result in death, physical disability and mental well childbearing age and the elderly [1]

In the case of patients with stroke, a stroke patients often experience trauma / head injury due to falls in the bathroom, fell on the stairs or after waking. Trauma / head injury in stroke patients require ongoing medical record to ensure further medical treatment. With minimal facilities, the scoring system becomes very necessary to assess the state of consciousness and prognosis of the patients experienced injuries. One way to determine the severity of head injuries in stroke patients is the use of medical records Glasgow Coma Scale (GCS). GCS itself based on the patient's response to eye opening, verbal function and various motoric functions of the various stimulus [2]. GCS scoring system on his own sometimes have problems, such as pain medications under investigation and response variables measured on the visual analog, some patients will be reported "no pain" after a certain time. They can not tell the lower levels of "no pain". To overcome this problem then scoring on the Glasgow Coma Scale will be given sensor on one particular value.

In some studies, the response variables of the specific research has the highest limit from time to time. The actual level of the highest scoring test takers can not be measured properly and this phenomenon is called the effect of the highest limit. Effect occurs when the upper limit in a study, test scale relative ease so that everyone receives a proportion of the maximum or near the maximum value can not be determined [3]. To handle data censored at the upper limit tobit developed and applied approach.

The approach taken is to use longitudinal regression tobit where medical records GCS were observed repeatedly during the 14 days when the patient is treated, will be modeled factors that affect the severity of head trauma patients. It is hoped that by knowing the factors that influence can be seen the severity of injury / trauma and can be given treatment in the healing of patients to the fullest

II. METHOD

A. *Tobit Regression*

Model tobit (Truncated Regression) or so-called censored regression is a regression analysis that is used to describe the relationship between the dependent variable and the independent variable where the dependent variable scale mix. Tobit The term was first proposed by James Tobin in 1958 were used to analyze the expenditures of the households in the United States to buy the cars [4]. Modeling tobit formed by first assuming the existence of a relationship linear between Y^* with variabel X expressed by :

$$y_i^* = x_i^T \beta + \varepsilon_i \tag{1}$$

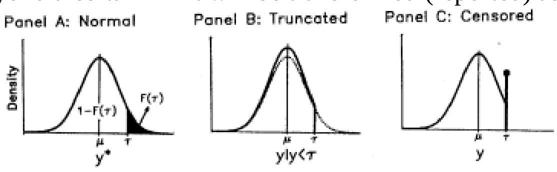
With y^* contains a latent variable that represents the value censored. When y^* with ceiling effects $y_i^* \geq \tau$, so the variabel respon (Y) cencored was definition likes:

$$y_i = \begin{cases} y_i^* = x_i^T \beta + \varepsilon_i & jika \ y_i < \tau \\ \tau & jika \ y_i \geq \tau \end{cases} \tag{2}$$

Where τ is threshold where $i = 1, 2, ..., n$ and n is the number of observations.

B. The Concept of Data Cencored

Sensor occurs when the observations were made on variables for the entire sample, but there are some observations on the response variable that has limited information. When a censored response variable, the value of observation beyond a certain limit will be transformed (reported) as a single value [5]



Long [8] explain that if you use all the data to the regression model to the data censored, will generate parameter values over estimate the intercept. Whereas if eliminating the observation that value is not known, will produce the coefficient parameters underestimate the slope and the intercept overestimate. And truncated cause correlations between predictor variables with residual, resulting in inconsistent estimates.

C. Longitudinal Data Analysis

Longitudinal data analysis is a study that refers to the observation that the measurement is repeated from time to time [6]. Such studies have appeared in various fields. In the field of medical study was conducted to measure the rehabilitation of stroke patients were observed at various times and circumstances. This study is very effective for studying the effects of time on certain characteristics.The main objective of the analysis was to determine the response of the middle value, expressed as a function of time. In general, longitudinal data set is written as follows:

$$\left(y_{ij}, t_{ij}\right) \quad i = 1, 2, ..., m; \quad j = 1, 2, ..., n_i \tag{3}$$

Where:

y_{ij} : measurement to j (from n_i measurement) to object i (from m object)

t_{ij} : time measurement y_{ij}

Longitudinal data is data obtained through a repeated observations carried out against a number of objects. Such data have appeared in various fields such as medicine, agriculture, economics. Most longitudinal studies designed to determine the value of the middle of the response as a function of time, with due regard to the role of the explanatory variables.

D. Longitudinal Tobit Analysis

For longitudinal data, tobit models can be defined in the same manner as in the classic longitudinal analysis, the underlying model y^* is a linear mixed models

$$y_{ij}^* \mid b_i = x_{ij}{}' \beta + z_{ij}{}' b_i + e_{ij} : N(0, \sigma^2) \tag{4}$$

Where's i refers to the subject i and j .

Estimation of the parameters of the model tobit approximated using Gaussian quadrature. An advantage of the Gaussian quadrature estimate is that the accuracy can be assessed by comparing with a different number of points quadrature. When quadrature obtained by assuming a normal, posterior density estimates of latent variables tend to work well for a continuing response and in large numbers.

E. Glasgow Coma Scale

Glasgow Coma Scale is a standardized scoring system to assess the neurological status of patients with head injury / awareness. GCS accurate value is used to direct treatment and for the prediction of patient outcome. GCS was first introduced in 1970 in Glasgow by Jennet and Teasdale. Rate Glasgow Coma Scale (GCS) is:

Table 1: Glasgow Coma Scale Score

No	**Item assessed**	**Skor**
1.	Opened the eyes responses	4 = Spontaneous 3 = Against the verbal stimulus 2 = Against the painful stimulus 1 = No respon
2	Verbal Responses	5 = Oriented on time 4 = Confused 3 = Words irregular 2 = Unclear voice 1 = No voices
3	Motoric responses	6 = obey ordered 5 = Shows the location of pain 4 = Avoid 3 = Abnormal flexion 2 = Abnormal extency 1 = No Respon

F. Stroke

Stroke is a major health problem for today's modern society. The sudden stroke can result in death, physical and mental disability both in their productive age and old age. Stroke is a disorder of neurological dysfunction acute caused by circulatory disorders, and sudden in onset (within seconds) or at least rapidly (within hours) with symptoms and signs according to the focal area of the brain that is impaired. In the case of patients with stroke, a stroke patients often experience trauma / head injury due to falls in the bathroom, fell on the stairs or after waking. Trauma / head injury in stroke patients require ongoing medical records to ensure further medical treatment.

III. RESULTS

A. Data Source

The data used in this study were taken from a longitudinal study of the rehabilitation of stroke patients in which the calculation includes the Glasgow Coma Scale, blood pressure, temperature and pulse rate in patients with stroke. Total sample consisted of 80 patients with stroke in Haji Surabaya hospital with the duration of treatment for 14 days.

B. Research Variable

Response variable (Y) used in this research is the score on the Glasgow Coma Scale (GCS) for the calculation of trauma / injury head stroke patients. GCS' sensor point based on the degree of severity of head injury. GCS' scores can be seen in table 2

Table 2 Respon Variable (Y)

Glasgow Coma Scale	**Score**
Mild Of Head Trauma/Injury	13-15
Middle Of Head Trauma/Injury	9-12
Hard Of Head Trauma/Injury	3-8

The predictor variables were included in this study are blood pressure, body temperature and pulse.

C. Results

In the tabel 3 presented descriptive statistic from the lower margin of Glasgow Coma Scale's score.

Table 3. Ceiling Proportion

GCS	Ceiling Proportion													
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
Mild (13-15)	4%	2%	7%	8%	12%	2%	3%	7%	23%	44%	14%	36%	15%	35%
MIddle (9-12)	7%	4%	7%	5%	12%	4%	3%	14%	23%	5%	21%	27%	12%	25%
Hard (3-8)	0%	0%	3%	3%	5%	4%	5%	8%	3%	2%	12%	12%	2%	23%

Table 3 displays the descriptive statistics (means and standard deviation) and different ceiling proportions across fourteen times. Therefore, different type have substantially different ceiling proportions. The highest score for stroke patiens in the mild group is 44% in day 10 and in the middle group is 27% in day 11. Because different proportions of Glasgow coma scale scores may have different magnitudes of influences on parameter estimates. The sample mean and covariance matrix of the generated data with ceiling threshold = 13 were presented in table 4.

Table 4 The Sammple mean and cov with CT=13

	Ceiling Threshold = 13			
	(Y)	X_1	X_2	X_3
Mean vector	7.8	9.2	10.3	12.2
Covariance Matrix				
(Y)	4.3	5.6	5.6	4.7
X_1	4.2	4.8	5.3	3.5
X_2	4.5	3.7	4.8	2.8
X_3	4.3	5.1	3.6	3.0

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M – 06

Multilevel Structural Equation Modeling For Evaluating The Effectiveness Of Remuneration In ITS Surabaya

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Abstract**—**In recent years, remuneration had a warm conversation among researchers. Remuneration has a goal to improve the performance of the state apparatus to become more efficient, effective, and more prosperous. The aim of this paper is to estimate multilevel structural equation modeling with latent variables to evaluating the effectiveness of present remuneration for administrative staff in ITS Surabaya. Multilevel Structural Equation Modeling is a method that combines Structural Equation Modeling and multilevel analysis simultaneously. The analysis is performed using secondary data from the research "Development and Indicator Specification of Present Remuneration For Administrative staff in ITS Surabaya". The hypothesis measure of the effectiveness of remuneration is a latent variable obtained by performance with the demographic factor like gender and latest education background. The opinion was expressed on a five ordered likert scale. The effectiveness of remuneration used three indicators. The results based on 100 administrative staff from 10 subject area indicate that performance is causally influence to the effectiveness of remuneration in individual level. While in activity level latest education background and gender are casually influence.

Keywords: *multilevel analysis, structural equation modeling, remuneration*

I. INTRODUCTION

In recent years, remuneration had a warm conversation among researchers. Remuneration is an attempt to change the payroll system and a calculation based on the difficult of responsibility, risk, scope of work and others, its can say the remuneration received some sort of reward for performance of a state apparatus in accordance with the positions and functions held. Remuneration has a goal to improve the performance of the state apparatus to become more efficient, effective, and more prosperous. The new remuneration started in 2013 under PP No. 88. While ITS will be start the implementation of remuneration in 2014. To explain the perception of the remuneration policy that has been applied in an organization requires research involving variable role in the level of group or activity unit other than the individual level.

The next problem is remuneration cannot be measured directly, so we need a capable method of solving these problems. Multilevel Structural Equation Modeling (MSEM) is a method that combines Structural Equation Modeling (SEM) and multilevel analysis simultaneously [1]. MSEM allows researchers to simultaneously test and estimate the relationship between exogenous and endogenous with many indicators in the clustered data where the lower levels will nest in the unit with the higher levels.

The analysis is performed using a two-level structural equation model with latent variables, where the effectiveness of remuneration in individual are considered as first level units and effectiveness of remuneration in subject area as second level units. The choice of a two-level analysis is justified to explain the nested data structure and to analyze in a single statistical model variables measured at different levels. In this case, individual levels are clustered in subject area and if they share unobserved factors it may expect related values of the response variables. As a result, observations may not be independent and identically distributed. In this case, a two level analysis allows to get accurate parameters and standard errors estimates and to explain the variability associated with each level. The analysis is limited to only two levels because we consider that the main effects on effectiveness of remuneration in individual level are exercised by the units to the next higher level.

II. MULTILEVEL STRUCTURAL EQUATION MODELING

Multilevel Structural Equation Modeling (MSEM) is an advanced SEM technique developed for multilevel research. MSEM can be applied to a wide range of applications that involve multilevel multivariate data, including multilevel factor analysis and multilevel path analysis models [1]. This approach formulates decomposition models for the individual (within) level and cluster (between) level. When the dependent variable are not normally distributed, for example ordered polytomous, ordinal categorical, binary or censored variables, multilevel model can be estimated with limited-information weighted least square [2].

A. Model Specification

Let y_{pij} be the *p*–th observed dependent variable, $p = 1,2,..., P$, for individual i, $i = 1,2,..., N_j$, in cluster $j = 1,2,..., C$, where N_j is the number of individuals in cluster j. Let x_{wqij} be the *q*–th observed individual predictor variable, $q = 1,2,..., Q_1$, for individual i in cluster j and x_{bqj} be the *q*–th observed cluster level predictor variable, $q = 1,2,..., Q_2$, observed for cluster j. To construct the latent variable model by defining an underlying normally distributed latent variable y^*_{pij}. If the *p*–th variable is normally distributed then $y^*_{pij} = y_{pij}$. If the *p*–th variable is categorical, for a set of parameters τ_{pk} [2].

$$y_{pij} = k \Leftrightarrow \tau_{pk} < y^*_{pij} < \tau_{pk+1} \tag{1}$$

The two-level model is constructed as [4].

$$y^*_{pij} = y_{wpij} + y_{bpj} \tag{2}$$

where y_{wpij} and y_{bpj} are normally distributed independent latent variables. Two separate latent variable models are defined for y_{wpij} and y_{bpj}. Suppose that η_{wmij} are normally distributed latent variables defined on the individual level, $m = 1,2,..., M_1$ and are normally distributed latent variables defined on the cluster level, $m = 1,2,..., M_2$. The vector variables defined as $y_{wij} = (y_{w1ij}, y_{w2ij},..., y_{wPij})$ and similarly y_{bj}, η_{wij}, η_{bj}, x_{wij}, and x_{bj}. The structural model on the within level is given by (3-4) and on the between level is given by (5-6).

$$y_{wij} = \Lambda_w \eta_{wij} + \varepsilon_{wij} \tag{3}$$

$$\eta_{wij} = B_w \eta_{wij} + \Gamma_w x_{wij} + \xi_{wij} \tag{4}$$

$$y_{bj} = \nu_b + \Lambda_b \eta_{bj} + \varepsilon_{bj} \tag{5}$$

$$\eta_{bj} = \alpha_b + B_b \eta_{bj} + \Gamma_b x_{bj} + \xi_{bj} \tag{6}$$

where the vector and matrix parameters Λ_w, Γ_w, B_w, Λ_b, Γ_b, B_b, ν_b, α_b as well as the thresholds parameters are to be estimated. The residual matrices ε_{wij}, ξ_{wij}, ε_{bj} and ξ_{bj} are independent and normally distributed with zero mean. Their respective covariances are denoted by Θ_w, Ψ_w, Θ_b and Ψ_b. In order to obtain identification, the variance of is fixed at 1 if the *p*–th variable is categorical [3].

B. Sample Estimates

The data is expressed as saturated model. It contains no latent constructs η_{wij} or η_{bj}, and full covariance matrices are fitted for the within and the between level variables. The thresholds of categorical variables have the same construction as in (1) and the underlying latent is defined as in the structural model specified in (2).

$$y_{pij} = k \Leftrightarrow t_{pk} < y^*_{pij} < t_{pk+1} \tag{7}$$

The structural part of the model is defined by

$$y_{wij} = \Pi_w x_{wij} + \in_{wij} \tag{8}$$

$$y_{bj} = \mu_b + \Pi_b x_{bj} + \in_{bj} \tag{9}$$

The residual vectors $\in_{wij}$ and $\in_{bj}$ are assumed normally distributed with 0 means and covariance matrices Σ_w and Σ_b, respectively. For identification purposes, if the *p*–th variable is categorical, the variance of $\in_{wpij}$ is fixed at 1 and the mean parameter μ_{pb} is fixed at 0.

The parameters in (8) and (9) are estimated in two stages. The first stage is for the estimation of univariate parameters: the between means μ_{bp}, the thresholds t_{pk}, the coefficients Π_{wpq} and Π_{bpq}, and the diagonal elements of the residual covariance matrix, Σ_{wpp} and Σ_{bpp}. At the second stage, the covariances of residuals, that is, the off-diagonal elements of Σ_w and Σ_b are estimated with bivariate likelihood methods, given the univariate estimates [3].

C. Structural Model Estimation

In the third stage of the two-level weighted least square estimation, the structural or restricted model parameters are estimated. Notice that the structural model (1-6) can be viewed as a restricted model nested within the unrestricted (7-9). The threshold estimation and multilevel structure define by [2].

$$y_{pij} = k \Leftrightarrow t^*_{pk} < y^*_{pij} < t^*_{pk+1} \tag{10}$$

$$y_{wij} = \Pi^*_w x_{wij} + \in_{wij} \tag{11}$$

$$y_{bj} = \mu^*_b + \Pi^*_b x_{bj} + \in_{bj} \tag{12}$$

where the covariance matrix $\in_{wij}$ and $\in_{bj}$ are Σ^*_w and Σ^*_b respectively. The index * refers to a further decomposition which includes the parameters to be estimated. The merged form of the structural model (4) and (6) are.

$$y_{wij} = \Lambda_w (I - B_w)^{-1} (\Gamma_w x_{wij} + \xi_{wij}) + \in_{wij} \tag{13}$$

$$y_{bj} = \nu_b + \Lambda_b (I - B_b)^{-1} (\alpha_b + \Gamma_b x_{bj} + \xi_{bj}) + \in_{bj} \tag{14}$$

First, the equations are solved in terms of the unstandardized (denoted by **) estimates, The unstandardized estimates implied by (1-6) are.

$$\Sigma^{**}_w = Cov(\in_w) = \Lambda_w (I - B_w)^{-1} \Psi_w (I - B_w)^{-1T} \Lambda^T_w + \Theta_w \tag{15}$$

$$\Sigma^{**}_b = Cov(\in_b) = \Lambda_b (I - B_b)^{-1} \Psi_b (I - B_b)^{-1T} \Lambda^T_b + \Theta_b \tag{16}$$

$$\Pi^{**}_w = \Lambda_w (I - B_w)^{-1} \Gamma_w \tag{17}$$

$$\Pi^{**}_b = \Lambda_b (I - B_b)^{-1} \Gamma_b \tag{18}$$

$$\mu^{**}_b = \nu_b + \Lambda_b (I - B_b)^{-1} \alpha_b \tag{19}$$

Let Δ_w be a *p*-dimensional diagonal matrix with 1 on diagonal if the *p*-entry is not categorical and $1/\sqrt{\Sigma^{**}_{wpp}}$ if the variable is categorical. Similarly, let δ_b be a *p*-dimensional vector with as the *p*-th entry 0 if *p*-th variable is not categorical and μ^{**}_{bp} if the *p*-th variable is categorical. To obtain the standardized estimates of the thresholds as well as the parameters in (15-19) the following definitions apply.

$$\Sigma^*_w = \Delta_w \Sigma^{**}_w \Delta_w \tag{20}$$

$$\Sigma^*_b = \Delta_w \Sigma^{**}_b \Delta_w \tag{21}$$

$$\Pi^*_w = \Delta_w \Pi^{**}_w \tag{22}$$

$$\Pi^*_b = \Delta_w \Pi^{**}_b \tag{23}$$

$$\mu^*_w = \Delta_w (\mu^{**}_b - \delta_b) \tag{24}$$

$$t^*_{pk} = \Delta_w (\tau_{pk} - \delta_b) \tag{25}$$

Finally the standardized estimates are united as σ^* in the same order as the unrestricted estimates in s. The weighted fit function is the following

$$F = (s - \sigma^*)W^{-1}(s - \sigma^*)^T \tag{26}$$

Minimizing the fit function with respect to the parameters of model (1-6) is the last stage of the estimation process. The weighted least square estimates are the parameter estimates that minimize F [2].

III. METHODHOLOGY

The analysis is performed using secondary data from the research "Development and Indicator Specification of Present Remuneration For Administrative Staff in ITS Surabaya". The effectiveness of remuneration is influenced by a number of variables, some of which are directly measurable usually call manifest variables, others are not directly measurable or latent variables. Some of researcher have had research about the relationship between the effectiveness of remuneration with performance [4],[5]. A total of 4 latent variables, 15 observed response variables and 2 observed explanatory variables are used. The latent variables are.

TABEL 1. THE OBSERVED RESPONSE VARIABLES

	Remuneration
y_1	Remuneration based on workload (grade / rank) carried
y_2	For jobs that require knowledge, skills and responsibilities are higher than other, have a higher remuneration
y_3	Income which is equivalent with private business making me feel stand working as a administrative staff in ITS
	Performance
y_4	I'm trying to be conscientious in completing tasks
y_5	I complete the work in accordance with the specified SOP
y_6	I tried to finish the work on time
	Motivation
y_7	I make every effort to overcome every obstacle I faced
y_8	I do not postpone a work given to me
y_9	I'm always trying to improve performance over time
	Characteristic of Subject Area
y_{10}	I felt that I could have a good career at where I work now
y_{11}	I love my job in a field that I do now
y_{12}	I feel comfortable working in ITS Surabaya
	Training Transfer
y_{13}	My logical reasoning power has increased after training
y_{14}	By training, I more easily understand the new tasks given to me
y_{15}	After training , I always do a job with full consideration

Meanwhile the observed explanatory variables are % of respondent who have latest educational background under diploma as x_1 and % of respondent who a man as x_2. The variables from y_1 to y_{15} are evaluated on a 5 ordered points scale ranging from 1 = "strongly disagree" to 5 = "strongly agree". Moreover note that the latent variable "Effectiveness of remuneration" is the only variable measured for the first level units and for the second level units (subject area). The hypothesized relationship between the latent variable effectiveness of remuneration, the observed indicators (measurement model), and other latent variables is defined by Figure 1.

IV. RESULT ANALYSIS

In this paper we used data from the result of the policy research survey conducted at ITS regarding the instruments of administrative staff performance which is titled "Development and Indicator Specification of Present Remuneration For Administrative Staff in ITS Surabaya". The survey population consisted of 698 administrative staff who get a remuneration while the respondents were 100 (14,33%) from 10 subject area using simple random sampling and proportional sample allocation. The data have a multilevel structure, with administrative staff nested within subject area. Of that 64% of the respondents who participated in the survey were man, 36% were woman. According to their latest background, 38% of the participant were have latest educational background as senior high school degree; 13% at diploma degree; 46% at bachelor degree; and 3% at magister degree.

Multilevel structural equation modeling is comprised of both measurement model and structural model. The multilevel measurement model, which is a multilevel confirmatory factor model, specifies how the latent factors are measured by the observed variables. The multilevel structural model contains the relationships between the latent factors [6]. The analysis is performed using a two-level structural equation model with latent variables, where the effectiveness of remuneration in individual are considered as first level units and effectiveness of remuneration in subject area as second level units.

The analysis is estimated using software Mplus 7.11 developed by Muthen, using the limited-information weighted least squares estimator indicated with "WLSMV". The analysis of the two-level data structure is firstly performed computing the intraclass correlation coefficient (ICC) for each indicator of the endogenous latent variable the effectiveness of remuneration. The ICC values for these 3 indicators ranged from 0.000 to 0.107. The results show a small level of association of the observed responses within each subject area. As a consequence, the proportion of variability due to the cluster level is very low.

The next step is analysis of the measurement model to specifies how the latent factor are measured by the observed variables. The measurement models show that the endogenous latent variable effectiveness of remuneration well measured by their respective indicators, for individual level. But in the higher level it seem that effectiveness of remuneration have a weak measured by their respective indicators. The measurement models seem significant also for the other latent variables, performance, motivation, characteristic of subject area and training transfer.

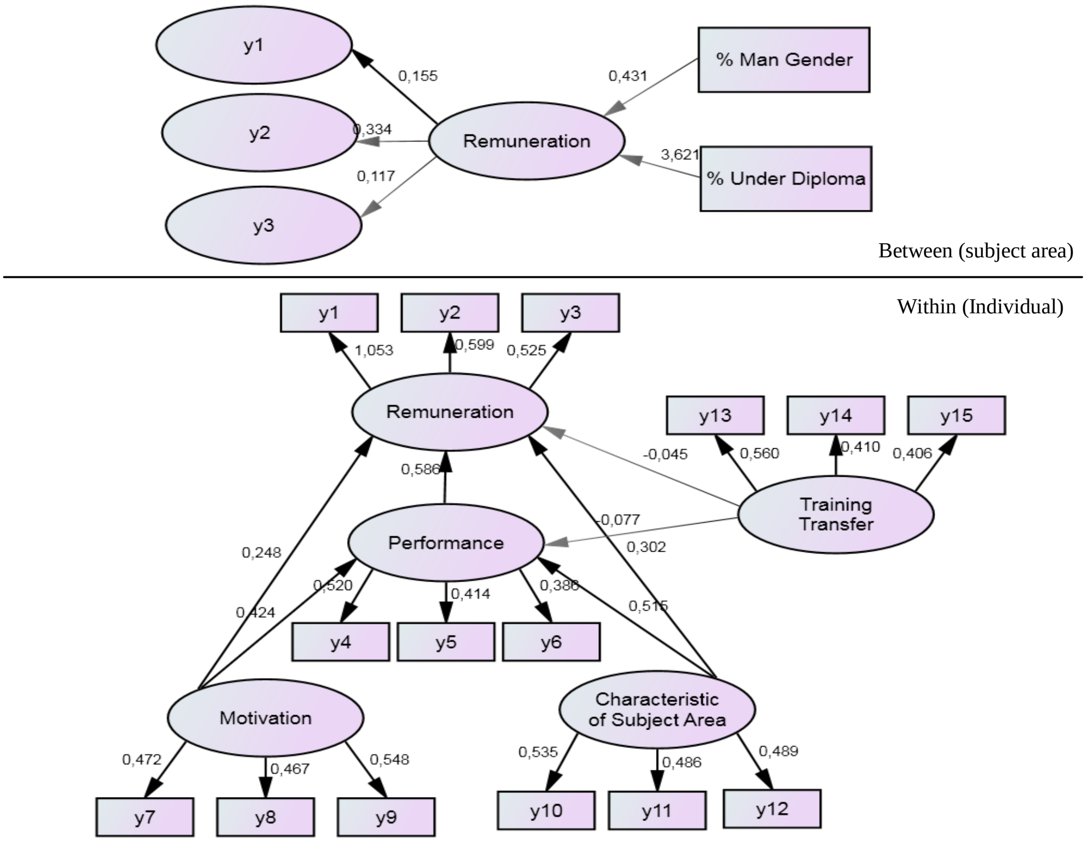

FIGURE 1. MULTILEVEL MODEL FOR EVALUATING THE EFFECTIVENESS OF REMUNERATION

In the third step, multilevel structural model was estimated both within (first) and between (second) level. The relationship between the latent variable at first level unit show that performance have a significant and positive direct effect on the endogenous latent variable, the effectiveness of remuneration. The direct effect of motivation and characteristic of subject area on effectiveness of remuneration is significant and positive. While the direct effect of training transfer on effectiveness of remuneration have a weak relationship and negative direct effect. As a result motivation and characteristics of subject area exert an indirect effect on the external effectiveness trough the performance. The indirect effect of the motivation on the effectiveness of remuneration is given by the product of the direct effects of the motivation on the performance and of the performance on the effectiveness of remuneration. Similarly, the indirect effect of the characteristic of subject area and training transfer on the effectiveness of remuneration. The analysis of the effects of the explanatory variables on the latent variable the effectiveness of remuneration in second level unit (subject area unit) have a weak influence and positive direct effect.

The last step, multilevel structural equation modeling must be evaluating with goodness of fit (fit indices). The model fit indices are acceptable. The MSEM fitted the data reasonably well with, CFI= 1,000, TLI= 1,009, and especially RMSEA= 0,000. The fit indices at this step show that hypothesis model has substantially stronger fit. The result of relationships is depicted graphically which distinguishes the within groups model (level 1), represented in the lower area of the diagram, from the between groups model (level 2), represented in the upper area of the diagram (Figure 1). The significant or strong relationships are represented with bold arrows ($p<0.10$). Weak relationships are represented with gray arrows.

V. Conclusion And Discussion

Institut Teknologi Sepuluh Nopember (ITS) Surabaya which was originally the Public Service Organization now is the State University of Law Firm which organizes state-owned and responsible for higher education in various disciplines around technology. ITS will start the implementation of the remuneration in the year 2014. If the remuneration program is perceived as fair and appropriate by the administrative staff , then the institution will be easier knowing potential administrative staff, maintain and motivate administrative staff to improve its performance so that institutions are able to produce a quality product on ultimately lead to the achievement of the vision ITS . So its necessary to evaluate the effectiveness of the remuneration for administrative staff.

The hypothesis measure of the effectiveness of remuneration is a latent variable obtained by evaluating performance with demographic factor like gender and latest education background. This model explains the effectiveness of remuneration taking into account the complex data structure where the individual are the first level units and the subject area the second level units. Cause organizations are naturally multilevel system. Individuals are nested within subject area, and they are respectively at different hierarchical levels.

The first level relationship highlights the crucial role played by the performance on the effectiveness of remuneration. Administrative staff strongly agree if higher performance have a higher remuneration too. On the performance have a direct effect the motivation, the characteristic of subject area and training transfer. The motivation, the characteristic of subject area and training transfer have also an indirect effect the effectiveness of remuneration through the performance.

The second level relationships show that % administrative staff who have a man gender and % administrative staff who have latest educational background under diploma have an influence on opinion respondent to the effectiveness of remuneration. The hypothesis model has a few limitation, some of these are attributable to the analysis method, the others to the available data. For the next step researcher can use much more data and variable. Cause in second level relationship between the effectiveness of remuneration and explanatory variables is weak. Even with this lack research, there is a belief that these results can be of some use in the policy determined and management of the stack holder in ITS Surabaya.

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M – 07

Cox Proportional Hazard Model with Multivariate Adaptive Regresion Spline

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Abstract— Events related to the survival time always happens in everyday life, one of which is time duration that need to recover from illness. Time that we need until the event happened is called survival data. Generally, not all of survival data can be observed and it is called data censored. One of statistical method that can be used to analyze and determine the survival rate of survival data is the cox proportional hazard models. In its development, the residuals of the cox proportional hazard (Cox PH) model can be used as response variable for regression function. The relationship between response variable and predictor variables often is not known the function of regression. So we are needed nonparametric regression. One of method nonparametric regression that can be used is Multivariate Regression Adaptive Spline (MARS). In this study, survival analysis is focused on the patients of HIV/AIDS which is a deadly disease. To determine survival rate of HIV/AIDS patients is used a hazard function and survival function with time duration patient stayed as variable. To know the other factors of the survival of HIV/AIDS patient is used Cox PH Models with MARS approach. The results showed that gender is one factor in the survival of HIV/AIDS patients, and treatment compliance, employment status, CD4 count, age and educational level.

Keywords: *Survival Analysis, Cox PH, MARS, HIV/AIDS*

I. INTRODUCTION

Survival analysis is a statistical analysis that is specifically used to analyze the data or cases related to the time duration until the event happened and there are data censored [1]. At first time, studied of survival is focused on the probability predictions of response, survival, average life expectancy and comparing the treatment of survival illustration experiment in humans. But survival analysis developed in the identification of risk factors and prognostic factors associated with the development of the disease [2]. One method of analysis that can be used for survival data are cox proportional hazards regression (Cox PH). Cox PH regression modeling can also be used to determine which combination of independent variables that influence in the model. In its development, Cox PH regression modeling can include relationships between predictor variables with the model function multivariate regression adaptive spline (MARS).

MARS is one of nonparametric regression method that does not depend on the assumption of a certain curve shape so it has flexibility in high dimensional data and modeling involves a lot of interaction with a few variables [3]. The variable responses in MARS modeling can use the residuals of the modeling Cox PH, so the survival modeling of MARS can be interpreted as MARS modeling the response variable is the residual result of modeling Cox PH [4]. The Previous research has been done to use of survival analysis with MARS approach in DBD cases, where the response variable of MARS models use *martingale residual* for uncensored data [5]. Then Cox proportional hazard and MARS used to analyze product sales with a electronic media system [6]. Previously, they had done research on survival analysis using MARS approach for the case of survival of heart patients in Germany, and show that the MARS method give better results than Cox PH regression [4].

In this study, the Regression Cox PH using MARS approach is used to determine the factors that influence survival of HIV/AIDS patients. Human Immunodeficiency Virus (HIV) is a virus that decrease the body's immune system so that the people affected by this virus will be susceptible to various infections and then causes *Acquired Immune Deficiency Syndrome* (AIDS). Research on HIV/AIDS in Indonesia is more emphasis on efforts to reduce the incidence of HIV/AIDS and how the healing response of

HIV/AIDS. One of them is a mixture survival modelling for HIV/AIDS cases in Semarang [7]. To determine the factors that affect the survival of HIV/AIDS.

II. LITERATURE REVIEW

A. Survival Analysis

Survival analysis is a statistical method that can be used to analyze data that related to start time (time origin) or start point until the specific event happened (end point) or failure event [8]

To determining the survival time, there are three factors required:

1. *Time origin* (starting point), is time to record and analyze an incident when the patients were first declared HIV/AIDS.
2. *Ending event of interest* (recent events) is the expired recording time. This time is useful to know the status of censored or not censored patient to be able to do analysis. Recent events in this study is the time when the HIV/AIDS patients were declared dead.
3. *Measurement scale for the passage of time* as a limit of the time of incident from the beginning to the end. The scale is measured in days, weeks, months, or years. In this study measuring scale used the time duration when the patients were suffering HIV/AIDS in months.

In survival analysis, there is difficulty data observing that is the possibility of some individual observations who cannot be observed from the start point to the end point, this situation is called the censored data [1]. In this study, there are three causes of censored data.

1. *Loss to follow up*, occurs when the patient decides to move another hospital or refuse to observe.
2. *Drop Out*, occurs the patient chooses to go home.
3. *Termination of Study*, occurs when the research period was ended while the patient has not reached the failure event.

B. Hazard Function and Survival Function

In survival analysis, there are two main functions that is survival function and hazard function [8]. Survival function is the basis of survival analysis, because it includes the probability of survival from the time varying provide important information about the survival data. Survival Function is an individual opportunity who can survive over time *t* [2], and usually denoted by.

$$S(t)=1-F(t)=1-\int_0^t f(u)\,du \tag{1}$$

$$S(t)=\exp\left[-\int_0^t \lambda(u)\,du\right] \tag{2}$$

Hazard Function is an individual probability to reach specific incidents at time interval $(t,\Delta t)$ with individual assuming to stay on at this time interval. And usually denoted by $\lambda(t)$. This function is used to express the *hazard rate* or the rate of cure and survival up to time-*t*.

$$\lambda(t)=\frac{f(t)}{S(t)} \tag{3}$$

Where $f(t)$ is probability density function (PDF) on the distribution of the estimated survival data, and it is known that:

$$\int_0^t f(u)\,du=1-S(t) \tag{4}$$

So generally, the relationship of survival function and cumulative hazard function based on that equation is as follows:

$$\Lambda(t)=-\ln\ \mathrm{S}(t) \tag{5}$$

C. Distribution Estimates

Estimation of distribution used to the survival data which in this study is duration of suffering HIV/AIDS patients to otherwise experience *failure event*. Estimation of distribution is conducted by

Anderson-Darling test (AD) because it has a strong strength and accurate if we compared with other distribution test [9].

Equation Anderson-Darling test statistic (AD) is as follows:

$$A^2 = -n - \frac{1}{n}\sum_{i=1}^{n}(2_i - 1)\left[\ln F(Y_i) + \ln F(Y_{n+1-i})\right] \tag{6}$$

Where: F = the cumulative distribution function of the conjecture distribution.
Y = survival time data.
n = number of sample

D. Cox Proportional Hazard Model

Regression modeling to determine the factors that influence survival data for uncensored data is called Cox Proportional Hazard Regression models [10]. Cox PH regression is used when the observed outcome was the length of time of an event. This Modeling is a log-linear relationship between X and the general function of hazard on T are as follows:

$$\lambda(t|X-x) = \lambda_0(t)e^{\beta x} \tag{7}$$

For variable X that has covariate, the equation used is as follows:

$$\lambda_i(t) = \lambda_0(t)e^{\beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p} \tag{8}$$

Where:

$\lambda_i(t) =$ hazard function for individual to $-i$

$\lambda_0(t) =$ baseline hazard

$\beta_1, \beta_2, \ldots, \beta_p =$ coefficient regression

$x_1, x_2, \ldots, x_p =$ variable value for individual to $-i$

The most important assumptions that must be met in the regression is Cox Proportional Hazard assumptions which means that the ratio of the hazard function is constant over time or equivalent to the statement that the ratio of the hazard function of an individual against another individual hazard function is proportional. This research will use the approach chart using log minus log survival plots to check the assumptions Proportional Hazard. According to the Cox regression model, the hazard function for failure individual-i for time-t can be written as in Equation (9) is as follows:

$$\lambda_i(t) = \lambda_0(t)\exp\left(\sum_{j=1}^{p}\beta_j x_j\right) \tag{9}$$

Modelling using Cox Proportional Hazard produces two types of residual, that is Martingale Residual and Deviance Residual that obtained from Cox Null Model. This study used Martingale Residual which serves as the response variable for modeling MARS. Residual Martingale equation is as follows:

$$M_i(t) = N_i(t) - \int_0^t Y_i(s)\lambda(s)\,ds \tag{10}$$

$$M_i(t) = N_i(t) - \hat{\Lambda}_i(t) \tag{11}$$

Where

$M_i(t)$ = Martingale Residual-i at time-t

$N_i(t)$ = The process of counting events (data uncensored given value of 1 and data censored given value of 0) for data-i at time-t

$Y_i(s)$ = Indicators, if subject-i is *under risk immediately* before-t

$\hat{\Lambda}_i(t)$ = Breslow estimator of the cumulative baseline hazard function

E. Multivariate Adaptife Regression Spline

Multivariate Adaptive Regression Splines (MARS) is one of the new flexible method for modeling high-dimensional regression data. MARS is a form of extension of the Basis Splines Functions where the number of basis function is the parameters of the model.

Some terms that need to be considered in the methods and modeling MARS is as follows,

1. *Knots* is the point of a regression line to form a region of a regression function.
2. *Basis Function* (BF) is a collection of some of the functions that are used to describe the relationship between the response variable and the predictor variable.
3. Interaction is a correlation between variables and the maximum number of interaction (MI) 1, 2, and 3.

The general equation MARS models are as follows:

$$f(x) = \alpha_0 + \sum_{m=1}^{M} \alpha_m \prod_{k=1}^{K_m} \left[s_{km} \cdot \left(x_{v(k,m)} - \tau_{km} \right) \right] + \varepsilon \tag{12}$$

Estimator model of multivariate adaptive regression splines or MARS [3]:

$$f(x) = \alpha_0 + \sum_{m=1}^{M} \alpha_m \prod_{k=1}^{K_m} \left[s_{km} \cdot \left(x_{v(k,m)} - \tau_{km} \right) \right] + \varepsilon \tag{13}$$

Where the first summation covers all the bases for a single variable functions, covering all the bases the second summation function for the interaction between two variables, the third summation includes all the base functionality for the interaction between the three variables and so on [3].

MARS modeling is determined by trial and error for the combination of BF, MI, and MO to get the value of minimum GCV. GCV equation is as follows:

$$GCV(M) = \frac{ASR}{\left[1 - \frac{\tilde{C}(M)}{N}\right]^2} = \frac{\frac{1}{N}\sum_{i=1}^{N}\left[y_i - \hat{f}_M(x_i)\right]^2}{\left[1 - \frac{\tilde{C}(M)}{N}\right]^2} \tag{14}$$

In the case of additive modeling suggested to use a value of d = 2, based on the decline in expectation value of ASR [3]. While suggests conventional value *d = 4* [1]. The smaller the value of d, the larger models which will produce with more functions of the base, and conversely the greater the value of d, the smaller models which will produce with fewer basis functions.

F. HIV/AIDS

Human Immunodeficiency Virus (HIV) is a virus that decrease the body's immune system so that the people affected by this virus will be susceptible to various infections and then causes *Acquired Immune Deficiency Syndrome* (AIDS). There are about 5 -10 million people living with HIV who do not yet show any symptoms but as a potential source of infection. AIDS is a disease that is very dangerous because it has a case fatality rate of 100% in five years, meaning that within 5 years after diagnosis of AIDS in upholding then all people will die [11]. Factors that affect the survival of people with HIV/AIDS are age, gender, education level, status employment, status marital, history ARV, absolute CD4 count, opportunistic infections, functional status, stage, and treatment compliance.

III. METHODOLOGY RESEARCH

A. Data Source

The data used in this research is secondary data on the medical records of HIV/AIDS patients in one hospital counted 100 data. Variables used in this research are:

Y : Survival Time
X_1 : Age
X_2 : Gender
X_3 : Education level
X_4 : Status of jobs
X_5 : Marital status
X_6 : History ARV

X_7 : absolute CD4 levels
X_8 : Opportunistic Infections
X_9 : Functional Status
X_{10} : Stadium
X_{11} : Compliance therapy

B. Method Analysis

a. Determine the survival data that will be used to eliminate the data censored.
b. Describing the characteristics of patients with HIV/AIDS
c. Predicting survival data distribution using the smallest of Anderson-Darling value
d. Determining the baseline hazard function
e. Estimating the survival function and cumulative hazard function
f. Using the Cox PH models to get Martingale residual,
g. Doing plotting data to know the Martingale residual predictor variables.
h. Modeling Cox PH with MARS approach through the following steps:
   1. Modeling with MARS combined Basis Function (22, 33, 44), Maximum Interaction (1, 2, 3), and the Minimum observation (0, 1, 2, 3)
   2. Getting the best model based on the value of the minimum GCV
   3. Modeling Cox Proportional Hazard with MARS approach
   4. Interpretation models
   5. Determine the level of interest for each of the significant variables in the model
i. Summing up the results of the analysis

IV. ANALYSIS AND DISCUSION

A. Descriptive Statistics

Before the description of the characteristics of patients with HIV/AIDS, then the description of the survival data were used.

TABLE 1. DESCRIPTIVE DATA SURVIVAL

N Total	n censored	n observation
100	51	49

Table 1 shows that of the 100 data obtained, there are 51 data classified in the data censored, where this data must be removed because it cannot be used in the survival analysis. It can be concluded that the survival data in this study there are as many as 49 data.

TABLE 2. DESCRIPTIVE PATIENTS HIV/AIDS

Variable	Characteristics	Number	Variable	Characteristics	Number
Age	Toddlers (0-5 years)	5	Absolute CD4 levels	>350	1
	Children (5-12 years)	1		200-350	5
	Adolescents (12-23 years)	2		<200	43
	Adults (>23 years)	41	Opportunistic Infections	< 2	17
Gender	Female	25		> 2	32
	Male	24	Functional Status	Normal	9
Education	Higher	11		Ambulatory	6
	Primary	21		lying	34
	None	17	Stadium	Stage I	12
Jobs	Working	31		Stage II	8
	Not Working	18		Stage III	15
Marital Status	Married	27		Stage IV	14
	Not Married	22	Compliance therapy	Comply	22
ARV	Ever	19		non-compliant	27

History	Never	30			

Table 2 shows the ingredients HIV/AIDS patients who experience even failure are aged above 23 years of age or older. With a CD4 count of less than 200.

B. Distribution Estimates

Estimation of the distribution is used to determine the distribution of survival data were used. The distribution function was used to estimate the survival function and cumulative hazard function. The distribution function is also used to determine the baseline hazard function which is used in the modeling.

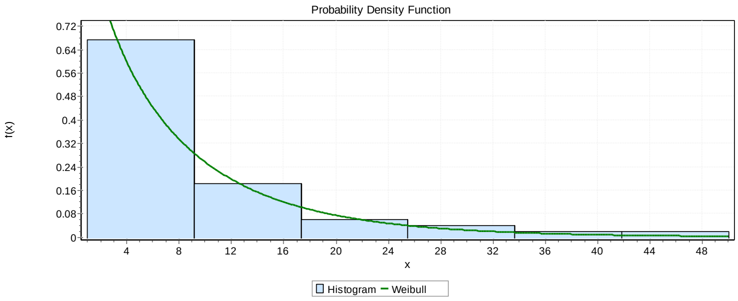


FIGURE 1. HISTOGRAM SURVIVAL DATA USED IN THE STUDY TO ESTIMATE THE DATA DISTRIBUTION.

Based on the estimation of the distribution using Anderson-Darling test, it is known that the smallest Anderson-Darling value is contained in a 2-parameter Weibull distribution in the amount of 1.93 with estimates of the parameters are and Based on estimates of parameters for two parameter Weibull distribution, then the baseline hazard function obtained are as follows :

$$\lambda_0(t|\eta,\gamma) = \frac{\gamma}{\eta}\left(\frac{t}{\eta}\right)^{\gamma-1}$$

$$= \frac{7.149}{0.859}\left(\frac{t}{0.859}\right)^{7.149-1}$$

$$= 8.322\left(\frac{t}{0.859}\right)^{6.149}$$

C. Estimated survival function and hazard function

Survival function is used to determine the probability of the patient's recovery, and cumulative hazard function is used to determine the rate of cure of HIV/AIDS. The estimation results of the survival function and the hazard function is as follows:

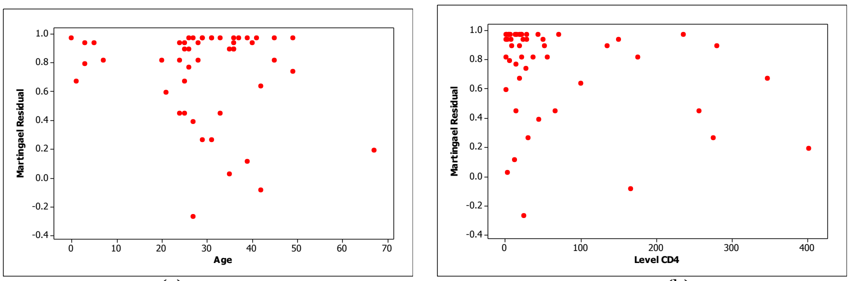
TABLE 3: ESTIMATED SURVIVAL FUNCTION AND CUMULATIVE HAZARD FUNCTION

Survival time	$S(t)$	$\Lambda(t)$	**Survival time**	$S(t)$	$\Lambda(t)$
1	0.969	0.031	14	0.666	0.406
2	0.939	0.063	15	0.575	0.553
3	0.899	0.106	16	0.542	0.612
5	0.831	0.185	18	0.478	0.738
7	0.811	0.209	24	0.445	0.810
8	0.791	0.234	27	0.412	0.887
11	0.769	0.262	28	0.377	0.976
12	0.720	0.328	36	0.337	1.087
13	0.694	0.365	50	0.281	1.269

Table 3 shows that the longer a patient is suffering from HIV/AIDS, the lower probabilities of survival for people is living with HIV/AIDS. On the contrary, the longer a patient suffering from HIV/AIDS, the higher the survival rate of patients with HIV/AIDS. It can be concluded that the probability of survival of patients with HIV/AIDS is inversely related to the survival rate of patients with HIV/AIDS.

D. Cox Proportional Hazard with Multivariate Adaptive Regression Spline

Before modeling with MARS, it is important to know the pattern of the relationship between the predictor variables and the response variable MARS modeling.



(a) (b)

FIGURE 2. SCATTER PLOT MARTINGALE RESIDUAL VS PREDICTOR VARIABLES (a) AGE, (b) THE ABSOLUTE CD4 LEVELS

Figure 2 shows that there is no particular pattern of variable X to variable Y. The pattern of relationships that do not tend to form patterns, showed that it could be used in MARS. MARS modeling done by trial and error for 36 combinations Basis Function (BF), Maximum Interaction (MI), and the Minimum Observation (MO) to get the best model based on the value of the minimum GCV.

Based on the results of trial and error combination BF, MI, and MO, the combination of which produces minimum GCV value is a combination of 22, 3, 1 with a value of GCV = 0.573 with R2 = 0.729. Based on the results of this combination, it is known MARS models produced are as follows:

$$Y = 0.721 + 0.391 * BF3 + 0.200 * BF4 - 0.001 * BF5 - 0.015 * BF7 - 0.012 * BF10$$
$$+ 0112 * BF11 - 2.603 * BF12 + 0.017 * BF14 - 0.088 * BF16 - 0.010 * BF18;$$

Where:
BF2 = (X11 = 2);
BF3 = max (0, X1 - 35,000) * BF2;
BF4 = max (0, 35,000 - X1) * BF2;
BF5 = max (0, X7 - 1000) * BF3;
BF7 = max (0, 275,000 - X7) * BF2;
BF8 = (X2 = 1) * BF2;
BF10 = max (0, X7 - 25,000) * BF8;
BF11 = max (0, 25,000 - X7) * BF8;
BF12 = (X4 = 1) * BF8;
BF14 = max (0, X7 - 257 000) * BF4;
BF16 = (X3 = 3) * BF4;
BF18 = max (0, X7 - 236,000);

Resulting in a model hazard rate or the rate of survival of patients with HIV/AIDS as follows:

$$\lambda(t) = \lambda_0(t)\exp\left(\hat{Y}\right)$$
$$= 8.322\left(\frac{t}{0.859}\right)^{6.149} \cdot \exp\begin{pmatrix} 0.721 + 0.391 * BF3 + 0.200 * BF4 - 0.001 * BF5 - 0.015 * BF7 - 0.012 * BF10 \\ +0112 * BF11 - 2.603 * BF12 + 0.017 * BF14 - 0.088 * BF16 - 0.010 * BF18; \end{pmatrix}$$

TABLE 4: INTERACTION ON BASIS FUNCTION

BF	Interactions	Specification
3 and 4	x1 and x11	Age and compliance
5	x7 * x1 and x11	CD4 levels, age and compliance
7	x7 and x11	CD4 levels and compliance
10	x2 and x11	Gender and compliance
11	x7 and x2	CD4 levels and gender
12	x7 * x2 and x11	CD4 levels, gender and adherence

14	x4 * x2 and x11	Employment, gender and adherence
16	x3* x1 and x11	The level of education, age and compliance

The Modeling results show that in general, the variables that affect the survival of patients with HIV/AIDS there are six variables: X1 (Age), X2 (Gender), X3 (Level of Education), X4 (Employment Status), X7 (Kadar CD4) and X11 (Compliance Therapy). The sixth of these variables has a good influence on the model, either individually or when interacting with other variables.

Table 4 shows the interaction of the variables that affect the survival of patients with HIV / AIDS. As for the variables that influence individual is adherence therapy and education level.

TABLE 5. VARIABLE INTEREST RATE

Variable	Importance	GCV
Gender	100	0.147
Therapy adherence	84.01	0.112
Employment Status	79.913	0.104
CD4 levels	78.947	0.102
Age	68.334	0.084
Education	16.149	0.032

Table 5 shows that gender have the largest contribution to the resulting model 100%. Then, the second largest contribution is in the amount of therapy adherence 84.010%. Then the third largest contribution is the employment status 79.913%, then the fourth biggest contribution is the Absolute CD4 cell count of 78.94%, the fifth biggest contribution is the Age of 68.334%, and the sixth biggest contribution is the level of education, amounting to 16 149.

V. CONCLUSION

HIV/AIDS patients who died is the average adult aged 23 years or older (age of majority), with CD4 levels below 200. Based on the modeling results with Cox Proportional Hazard MARS approach, which used a combination Basis Functions, Maximum interaction and minimum His observations are 22, 3, and 1 with a minimum GCV value was 0.028. Variables influencing the survival of patients with HIV/AIDS in individuals is age and compliance, levels of CD4 and compliance, gender and adherence, levels of CD4 and gender, CD4 count, gender and adherence, CD4 count, age and compliance, employment, gender and adherence, education level, age and compliance. Gender have the largest contribution to the resulting model, by 100%. Then, the second largest contribution is in the amount of therapy adherence 84.010%. Then the third largest contribution is the employment status of 79.913%, then the fourth biggest contribution is the Absolute CD4 cell count of 78.947%, the fifth biggest contribution is the Age of 68.334%, and the sixth biggest contribution is the level of education, amounting to 16.149%.

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M – 08

Parameter Estimation and Statistical Test in Modeling Geographically Weighted Poisson Inverse Gaussian Regression

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Abstract**—**Poisson regression is a member of Generalized Linear Models (GLMs) family which is derived from a Poisson distribution. Poisson distribution is a discrete distribution with the value of positive integer random variable so that it becomes a good choice for count data modeling. Poisson distribution is only determined by one parameter that defines both the mean and variance of the distribution. In Poisson regression there is an assumption that must be complete, that are mean and variance of the response variable should be the same (equidispersion). While, some of the count data potentially violates these assumptions because due to overdispersion (variance is greater than the mean). Therefore, modeling the count data is not sufficient with a simple Poisson regression. Poisson Inverse Gaussian Regression (PIGR) is a regression which is derived from mixed Poisson distribution that is designed for count data modeling with overdispersi case. PIGR will produce global model that is assumed to be valid in all areas in which the data was taken. But of course every region has different geographical conditions, social, cultural and economic. Thus, the development of a regression model that considers spatial effect, which is Geographically Weighted Regression (GWR) needs to be employed. By providing a weighting based on the location of the region, the GWR models will generate different local models for each region. Furthermore, the response variable must follow the PIG distribution so development will be Geographically Weighted Poisson Inverse Gaussian Regression (GWPIGR). Parameter estimation is done using Maximum Likelihood Estimation (MLE) and hypothesis testing conducted by Maximum Likelihood Ratio Test (MLRT).

Keywords: *Geographically Weighted Poisson Inverse Gaussian Regression, Maximum Likelihood Estimation, Maximum Likelihood Ratio Test.*

I. INTRODUCTION

Poisson regression is one of the family members of Generalized Linear Models (GLMs) derived from a Poisson distribution. Poisson distribution is a discrete distribution with the value of the random variable a positive integer so it becomes a good choice for discrete data modeling. Poisson distribution is determined solely by a single parameter that defines both the mean and variance of the distribution. Thus, in a Poisson regression there is an assumption that must be fulfilled which is the mean and variance of the response variable should be the same (equidispersion). But most of the discrete data found in the case suffer overdispersion [1].

But in reality these assumptions violations often occur when variance is smaller than the mean (underdispersion) or variance is greater than the mean (overdispersion). To overcome overdispersion case, some form of statistical model is employed by mixing Poisson distribution with the other distribution both discrete and continuous (mixed Poisson distribution). Mixed Poisson distribution is an alternative solution to overcome overdispersion case, but only a few distributions that are often used in research due to complicated calculations. One of them is the Poisson Inverse Gaussian distribution (PIG) which is the mix of Poisson distribution with random effects that follow Inverse Gaussian distribution. This distribution was first introduced by Holla in 1966 [2].

The development of regression models that considers the spatial heterogeneity, is called Geographically Weighted Regression (GWR). By providing a weighting based on the position or distance of an observation area with the observation area other then GWR models will produce local models that vary in each region. So this research using modeling Poisson Inverse Gaussian Geographically Weighted Regression (GWPIGR).

II. METHODS

Regression analysis is a statistical method used to model the relationship between the response variable and one or more predictor variables. Not all regressions have a response variable that follows a normal distribution. If the response variable follows the Poisson Inverse Gaussian distribution (PIG), then the regression is called regression PIG. Regression PIG includes global regression, while the local form of PIG called Geographically Weighted Regression Poisson Inverse Gaussian (GWPIGR).

A. Poisson Distribution

Poisson distribution is a probability distribution for the events that happen rarely, where the observation depends on the specific time intervals or in a particular area with a discrete response and one or more independent predictor. The time interval can be measured in minute, day, week, month, even year [3]

Probability density function follows:

$$p(y;\ \mu) = \frac{e^{-\mu}\mu^{y}}{y!} \text{ for } y = 0, 1, 2, \ldots \text{ and } \mu > 0 \tag{1}$$

With mean and variance of the same value is determined by:

$$E(Y) = Var(Y) = \mu \tag{2}$$

B. Inverse Gaussian Distribution

Inverse Gaussian has two parameters and probability density function that can be written as follows:

$$f(y) = (2\pi y^3\sigma)^{-0,5} e^{-(y-\mu)^2/2y\mu^2\sigma^2}, y > 0 \tag{3}$$

With mean and variance are written as:

$$E(Y) = \mu \text{ and } Var(Y) = \sigma^2\mu^3 \tag{4}$$

Where σ^2 is the parameter of dispersion. Inverse Gaussian is used in cases with extreme skewness. The name itself comes from the inverse Gaussian cumulant function which has inverse relationship with kumulant function (the natural logarithm of the function of MGF) normal distribution / Gaussian distribution [4].

C. Poisson Inverse Gaussian Distribution

PIG probability density distribution can be calculated as follows:

$$P(Y = y|\mu) = \frac{\mu^y e^{\frac{1}{\tau}}}{y!}\left(\frac{2}{\pi\tau}\right)^{\frac{1}{2}}(2\mu\tau + 1)^{-\left(\frac{y-\frac{1}{2}}{2}\right)} K_{y-\frac{1}{2}}\left(\frac{1}{\tau}\sqrt{2\mu\tau + 1}\right) \tag{5}$$

While Bessel functions [5] is:

$$K_{\frac{1}{2}}(a) = K_{-\frac{1}{2}}(a) = \left(\frac{\pi}{2a}\right)^{\frac{1}{2}} e^{-a},$$
$$K_{\frac{3}{2}}(a) = \left(1 + \frac{1}{a}\right)K_{\frac{1}{2}}(a). \tag{6}$$

D. Poisson Inverse Gaussian Regression

Poisson Inverse Gaussian Regression model can be written as follows:

$$y_i \sim PIG\ [\mu_i]$$
$$\mu_i = e^{\mathbf{x}_i^T\beta} \text{ or } ln(\mu_i) = \mathbf{x}_i^T\boldsymbol{\beta} \tag{7}$$

With

$$\mathbf{x}_i{}^T = [1 \quad x_{1i} \quad x_{2i} \quad \cdots \quad x_{ki}]$$
$$\boldsymbol{\beta} = [\beta_0 \quad \beta_1 \quad \beta_2 \quad \cdots \quad \beta_k]^T$$

Where $i = 1, 2, \ldots, n$ is the number of observations.

Probability density function follows::

$$P(Y = y_i|\mathbf{x}_i;\boldsymbol{\beta};\tau) = \left\{\frac{e^{\mathbf{x}_i^T\boldsymbol{\beta}y_i}e^{\frac{1}{\tau}}}{y_i!}\left(\frac{2}{\pi\tau}\right)^{\frac{1}{2}}\left(2^{e^{\mathbf{x}_i^T\boldsymbol{\beta}}}\tau+1\right)^{-\frac{\left(y_i-\frac{1}{2}\right)}{2}}K_{si}(z_i)\right\} \tag{8}$$

E. Procedures

Step 1. Determine the density function of the opportunities GWPIGR models. Step 2. Determine GWPIGR likelihood function on the model. Step 3. Determine the natural logarithm of the likelihood function. Step 4. Calculate first partial derivative of the natural logarithm function. Step 5. Calculate the second partial derivative of the natural logarithm function. Step 6. Calculate estimates $\boldsymbol{\beta}$ and τ. If the previous steps resulting equation that is not close the form, Fisher Scoring Algorithm is employed. Step 7. Do hypothesis testing simultaneously using MLRT and partialy using Z-test.

III. RESULT AND DISCUSSION

Spatial data is data collected from different spatial locations and indicates the existence of dependence between the measurement data by location. Consequently, if data model using ordinary linear regression, it will generate autocorrelation and heterogeneity in the data. There are several methods to overcome the problem, one of them is the Geographically Weighted Regression Poisson Inverse Gaussian method using Maximum Likelihood Estimation (MLE).

A. Parameter Estimation Geographically Weighted Poisson Inverse Gaussian Regression Model

Geographically Weighted Poisson Inverse Gaussian regression is a method that can be used to analyze the data count suffering overdispersion by considering the spatial aspect. This research will be carried out with the parameter estimation using Maximum Likelihood Estimation (MLE).

Geographically Weighted Poisson Inverse Gaussian Model:

$$\begin{aligned}\mu(u_i,v_i) &= exp\left(\beta_0(u_i,v_i)+\beta_1X_{1i}(u_i,v_i)+\beta_2X_{2i}(u_i,v_i)+\cdots+\beta_kX_{ki}(u_i,v_i)\right)\\ &= e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)}\end{aligned} \tag{9}$$

Where y_i is the value of the response variable observation i[th] location, x_{ik} is the value of predictor variable k observation at (u_i,v_i) locations, dan $\beta_k(u_i,v_i)$ is the regression coefficient for each location (u_i,v_i).

The first step in determining the parameter estimation is to determine the density function opportunities:

$$P(Y = y_i|\boldsymbol{x}_i;\boldsymbol{\beta};\tau) = \frac{e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)y_i}e^{\frac{1}{\tau}}}{y_i!}\left(\frac{2}{\pi\tau}\right)^{\frac{1}{2}}\left(2e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)}\tau+1\right)^{-\frac{\left(y_i-\frac{1}{2}\right)}{2}}K_{si}(z_i) \tag{10}$$

The second step determines the likelihood function of the density function chances

$$L(\boldsymbol{\beta},\tau) = \prod_{i=1}^{n}\frac{e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)}e^{\frac{1}{\tau}}}{y_i!}\left(\frac{2}{\pi\tau}\right)^{\frac{1}{2}}\left(2e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)}\tau+1\right)^{-\frac{\left(y_i-\frac{1}{2}\right)}{2}}K_{si}(z_i) \tag{11}$$

The third step is to transform the likelihood function ln:

$$\begin{aligned}l(\boldsymbol{\beta}(u_i,v_i),\tau) = &\sum_{i=1}^{n}y_i\ln\left(e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)}\right)+\frac{n}{\tau}-\ln\left(\sum_{i=1}^{n}y_i!\right)+\frac{n}{2}\ln\left(\frac{2}{n}\right)-\frac{n}{2}\ln\tau\\ &-\sum_{i=1}^{n}\left(\frac{2y_i-1}{4}\right)\ln\left(2e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)}\tau+1\right)+\sum_{i=1}^{n}\ln K_{si}(Z_i)\end{aligned} \tag{12}$$

The fourth step is to find the first partial derivatives of the parameters $\beta(u_i,v_i)$ of the natural logarithm function by adding a weighting:

$$\frac{\partial l^*}{\partial\boldsymbol{\beta}(u_i,v_i)} = \sum_{i=1}^{n}\left\{\left(y_i - M_{(y_i)}(w_{ij})e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)}\right)x_i^T\right\} \tag{13}$$

Next is determine first partial derivatives of the parameters τ:

$$\frac{\partial l^*}{\partial\tau} = \sum_{i=1}^{n}\left\{-\frac{1}{\tau^2}+\frac{M_{(y_i)}(w_{ij})\left(e^{\mathbf{x}_i^T\boldsymbol{\beta}(u_i,v_i)}\tau+1\right)}{\tau^2}-\frac{y_i}{\tau}\right\} \tag{14}$$

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Where

$$M_{(y_i)} = \frac{1}{\sqrt{2e^{x_i^T\beta(u_i,v_i)}\tau+1}} \frac{K_{y_i+\frac{1}{2}}(z)}{K_{y_i-\frac{1}{2}}(z)} \tag{15}$$

The fifth step is to determine a second partial derivatives against $\beta(u_i,v_i)$ and τ. The second derivatives are written as follows:

$$\frac{\partial^2 l^*}{\partial\beta\partial\beta^T} = \frac{\sum_{i=1}^{n}\left\{\left(y_i - M_{(y_i)}(w_{ij})e^{x_i^T\beta(u_i,v_i)}\right)x_i^T\right\}}{\partial\beta^T} \tag{16}$$

For the next is the first derivative of the β second descent to τ

$$\frac{\partial^2 l}{\partial\beta\partial\tau} = \frac{\sum_{i=1}^{n}\left\{\left(y_i - M_{(y_i)}(w_{ij})e^{x_i^T\beta(u_i,v_i)}\right)x_i^T\right\}}{\partial\tau} \tag{17}$$

The next second derivative is the second derivative of the likelihood function of the first derivative τ, is:

$$\frac{\partial^2 l}{\partial^2\tau} = \frac{\sum_{i=1}^{n}\left\{-\frac{1}{\tau^2}+\frac{M_{(y_i)}(w_{ij})\left(e^{x_i^T\beta(u_i,v_i)}\tau+1\right)}{\tau^2}-\frac{y_i}{\tau}\right\}}{\partial\tau} \tag{18}$$

From the results of the above derivative obtained explicit equation then to solve these equations RS algorithm and CG algorithm are employed. Likelihood function is maximized by using Fisher Scoring Algorithm. If the above equation and non-linear implicit equations within the parameters $\boldsymbol{\beta}$ and τ so as to obtain estimates of the parameters $\boldsymbol{\theta} = [\boldsymbol{\beta}^T \quad \tau]$, function is maximized by using Fisher Scoring Algorithm, by the following equation:

$$\hat{\boldsymbol{\theta}}_{(r+1)} = \hat{\boldsymbol{\theta}}_{(r)} + \mathbf{I}^{-1}\left(\hat{\boldsymbol{\theta}}_{(m)}\right)\mathbf{D}\left(\hat{\boldsymbol{\theta}}_{(m)}\right), \tag{19}$$

Where

$$\hat{\boldsymbol{\theta}} = \left(\hat{\boldsymbol{\beta}}^T, \hat{\tau}\right) \tag{20}$$

$$\boldsymbol{D}\left(\hat{\boldsymbol{\theta}}\right) = \left(\frac{\partial l}{\partial\hat{\tau}}, \frac{\partial l}{\partial\hat{\boldsymbol{\beta}}^T}\right)^T \tag{21}$$

$$\mathbf{I}\left(\hat{\boldsymbol{\theta}}_{(m)}\right) = -E\begin{bmatrix} \frac{\partial^2 l}{\partial\tau^2} & \frac{\partial^2 l}{\partial\tau\partial\boldsymbol{\beta}} \\ \frac{\partial^2 l}{\partial\boldsymbol{\beta}\partial\tau} & \frac{\partial^2 l}{\partial\boldsymbol{\beta}^T\partial\boldsymbol{\beta}} \end{bmatrix} \tag{22}$$

$$\mathbf{H}\left(\hat{\boldsymbol{\theta}}_{(m)}\right)_{(k+1)(k+1)} = \begin{bmatrix} \frac{\partial^2 l}{\partial\tau^2} & \frac{\partial^2 l}{\partial\tau\partial\boldsymbol{\beta}} \\ \frac{\partial^2 l}{\partial\boldsymbol{\beta}\partial\tau} & \frac{\partial^2 l}{\partial\boldsymbol{\beta}^T\partial\boldsymbol{\beta}} \end{bmatrix}_{\theta=\theta_{(m)}} \tag{23}$$

Hessian matrix is a matrix that contains the second derivative of the likelihood function of the parameter $\boldsymbol{\beta}$ and τ. The steps as follows Fisher Scoring Algorithm:

1) Determining the initial vector parameter $\hat{\boldsymbol{\theta}}_0$ with assuming the data meet the multiple linear regression model.
2) Forming gradient vector $\mathbf{D}\left(\hat{\boldsymbol{\theta}}\right)$ by substituting equation (13) and (14) into the equation $\mathbf{D}\left(\hat{\boldsymbol{\theta}}\right)$
3) Hessian matrix forming (23) by substituting equation (16), (17), and (18) into the equation (22)
4) Fisher information matrix formed $\mathbf{I}\left(\hat{\boldsymbol{\theta}}_{(0)}\right)$
5) inserting values $\hat{\boldsymbol{\theta}}_{(0)}$ thus obtained gradient vector $\mathbf{D}\left(\hat{\boldsymbol{\theta}}_{(0)}\right)$ and hessian matrix $\mathbf{H}\left(\hat{\boldsymbol{\theta}}_{(0)}\right)$
6) Starting from $m = 0$ iterating the equation $\mathbf{I}^{-1}\left(\hat{\boldsymbol{\theta}}_{(m)}\right)$, value $\hat{\boldsymbol{\theta}}_{(m)}$ is a set of parameter estimator convergent iteration to- m.

7) If you have not obtained when the parameter estimation convergent iteration to- m, then proceed back to step 6 to iteration to- $m+1$. Iteration will stop when the value of $\| \hat{\boldsymbol{\theta}}_{(m+1)} - \hat{\boldsymbol{\theta}}_{(m)} \| \leq \varepsilon$ and $\varepsilon > 0$ is a very small number [6].

B. Statistical Test

Parameter and hypothesis testing in the model are done simultaneously using MLRT and partially using Z-test. The test statistic used in the simultaneous test likelihood ratio is a statistical measure that was formed by determining the parameters set under the population and under the null hypothesis.

Hypotheses to test the significance of the parameters $\boldsymbol{\beta}$.

H_0: $\beta_1(u_1, v_1) = \beta_2(u_2, v_2) = \cdots = \beta_k(u_k, v_k) = 0$

H_1: at least one $\beta_l(u_l, v_l) \neq 0$ with $l = 1, 2, \ldots, k$

Here is a statistical test used:

$$G = -2\, ln\left(\frac{L(\hat{\omega})}{L(\hat{\Omega})}\right) \tag{24}$$

in which the value of $L(\hat{\omega})$ and $L(\hat{\Omega})$ are the maximum likelihood value for each model in which $\hat{\boldsymbol{\beta}}$ and $\hat{\tau}$ is the result of parameter estimation. Determine the rejection region H_0 if $G_{hit} > \chi^2_{(\alpha,v)}$.

For the partial test parameter β using the hypotheses:

H_0: $\beta_l(u_i, v_i) = 0$

H_1: $\beta_l(u_i, v_i) \neq 0$, with $l = 1, 2, \ldots, k$

Here is a statistical test used

$$Z = \frac{\hat{\beta}_l}{SE(\hat{\beta}_l)} \tag{25}$$

To reject H_0 if $|Z_{hit}| > Z\alpha_{/2}$ where α is the significance level used.

While the partial test parameter τ using the hypotheses:

H_0: $\tau = 0$

H_1: $\tau \neq 0$

Here is a statistical test used:

$$Z = \frac{\hat{\tau}}{SE(\hat{\tau})} \tag{26}$$

To reject H_0 if $|Z_{hit}| > Z\alpha_{/2}$ where α is the significance level used.

IV. CONCLUSION

Parameter estimation of Geographically Weighted Poisson regression model using the Inverse Gaussian Maximum Likelihood Estimation (MLE). In the process of parameter estimation, equation obtained is not close the form, so it requires iteration method employing Fisher Scoring Algorithm. Hypothesis testing is done simultaneously using Maximum Likelihood Ratio Test and partially using Z-test .

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M – 09

Spatial Extreme Value Using Bayesian Hierarchical Model For Precipitation Return Levels Prediction

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Abstract—Extreme precipitation is a rare natural phenomenon categorized as one of extreme climates indicator. It leads to natural disasters such as floods and landslides. Prediction of precipitation return level, i.e. quantile which has probability 1/m of being exceeded in m period, become quite important to reduce the negative impact caused by this extreme event. The link between observation recorded on a particular time frame and quantities of longer time scales such as return level is provided by Extreme Value Theory (EVT) commonly used to learn the behaviors of extreme events. Given the observations are recorded from several locations, the extreme events at different locations are driven by geographical and climatologically factors. Unfortunately, the data of these factors are not always available. In this study, the spatial Bayesian hierarchical model (BHM) was employed to update the information in the likelihood that is not fully described by those unobservable covariates. The proposed method was applied to predict the extreme precipitation return level in Lamongan district, East Java, Indonesia. The Peak Over Threshold (POT) scheme was used to obtain extreme observations. The prior distribution was employed to update the likelihood of Generalized Pareto Distribution as an asymptotic distribution of exceeding resulted from POT procedure. The empirical results showed that the return level got higher for longer periods.

Keywords: *Extreme value theory, Peaks Over Threshold, Bayesian hierarchical model, spatial, return level.*

I. INTRODUCTION

Extreme value theory (EVT) is a method that is commonly used to analyze extreme natural events. Such extreme events associated with the location are called spatial extreme value. The intensive rain that usually happens during the rainy season can cause floods and landslides. These disasters are examples of negatives effect caused by extreme events. The studies to learn these extreme phenomena are quite important to predict and anticipate their occurrence in the future.

The EVT is used to analyze the heavy-tailed distribution of the extreme events. There are two approaches used EVT: (i) Block Maxima (BM) approach that has the Generalized Extreme Value (GEV) distribution and (ii) Peaks over Threshold (POT) approach that follows the Generalized Pareto Distribution (GPD) distribution. These research employed POT scheme. The characteristics of the GPD are expressed by the three parameters of EVT, i.e. threshold (u), scale (σ), and shape (ξ).

One of the most important things in the EVT is to calculate the value of return level, i.e. the probability of occurrence of a particular level of extreme events in the coming period. Knowledge of the return level is important for disaster mitigation and for the preparation of long-term programs [1]. This paper discusses the procedures to obtain the parameters estimates GPD and to calculate the return level using Bayesian Hierarchical Model (BHM). The BHM is chosen because it has some advantages, for instance, it able to accommodate geography and climatology at each level of the hierarchy structure.

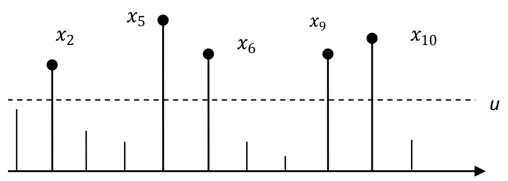
This paper is organized as follows. This section is followed by a section for a method that briefly discuss POT and BHM. The next part is used to describe the data and research methodology. The last part gives conclusion and suggestions.

II. LITERATURE REVIEW

In this part is discussed how the procedure was done to model the spatial extreme value by using the POT approach that follows GPD combined with BHM.

A. *Peaks Over Threshold (POT)*

POT is one of the methods to identify the extreme value by using the so-called threshold (u) as a reference value. The data above the threshold will be identified as extreme values. Figure 1 shows how to collect extreme data using POT. The values of x_2, x_5, x_6, x_9, and x_{10} are larger than the threshold (u) therefore these six data are considered as extreme values that will be used in further analysis.



F FIGURE 1. ILLUSTRATION OF EXTREME DATA COLLECTION USING POT

The higher threshold is the higher probability that the extremes will approach the GPD [2]. The probability density function (pdf) of GPD is formulated as follow:

$$f\left(x-u\right)=\begin{cases}\dfrac{1}{\sigma}\left(1+\dfrac{\xi\left(x-u\right)}{\sigma}\right)^{-\frac{1}{\xi}-1} & ,\xi\neq 0\\[2ex] \dfrac{1}{\sigma}\exp\left(-\dfrac{\left(x-u\right)}{\sigma}\right) & ,\xi=0\end{cases}\tag{1}$$

where $0 \le \left(x-u\right) \le \infty$ if $\xi \ge 0$ and $u \le \left(x-u\right) < u-\frac{\sigma}{\xi}$ if $\xi < 0$. The σ and ξ in (1) represent scale parameter and shape parameter (the tail index), respectively.

B. *Parameter Estimation of Generalized Pareto Distribution*

Parameter estimation of GPD can be done using several ways. One of them commonly used is a Maximum Likelihood Estimation (MLE) that maximizes the likelihood function of $y_1, y_2, \ldots, y_n$, where $y = x-u$. Therefore, the equation (1) is rewritten in (2) as follows:

$$f\left(\xi,\sigma,y\right)=\begin{cases}\dfrac{1}{\sigma}\left(1+\dfrac{\xi y}{\sigma}\right)^{-\left(\frac{1}{\xi}+1\right)} & ,\xi\neq 0\\[2ex] \dfrac{1}{\sigma}\exp\left(-\dfrac{y}{\sigma}\right) & ,\xi=0\end{cases}\tag{2}$$

The log-likelihood function of (2) is expressed as:

$$\ln L\left(\xi,\sigma\left|y_1,y_2,\ldots,y_n\right.\right)=-n\ln\sigma-\left(\frac{1}{\xi}+1\right)\sum_{i=1}^{n}\ln\left(1+\frac{\xi y_i}{\sigma}\right)\tag{3}$$

The first derivative of log-likelihood with resct to each parameters are:

$$\frac{\partial \ln L}{\partial \xi} = \frac{1}{\xi^2}\sum_{i=1}^{n}\ln\left(1+\frac{\xi y_i}{\sigma}\right)-\left(\frac{1}{\xi}+1\right)\sum_{i=1}^{n}\frac{y_i}{\left(\sigma+\xi y_i\right)} \tag{4}$$

$$\frac{\partial \ln L}{\partial \sigma} = \sigma^{-1}\left(-n+\left(1+\xi\right)\sum_{i=1}^{n}\frac{y_i}{\sigma+\xi y_i}\right) \tag{5}$$

The solution for shape parameter estimate using MLE is not close form. The Newton-Raphson was employed to solve this issue.

C. Determination of the Threshold

The extreme values were obtained once the threshold (*u*) was determined as a reference value. The determination of the threshold aims to find the optimum balance in order to obtain the minimum error. In this paper, the Mean Residual Life Plot (MRLP) was used to determine the threshold with the following steps.

1. First, making the MRP with the coordinates of the points based on the following equation,

$$\left\{\left(u, \frac{1}{n_u}\sum_{i=1}^{n_u}\left(x_{(i)}-u\right)\right): u < x_{maks}\right\} \tag{6}$$

   where n_u is the number of observations above the threshold. The linear function of *u* is:

$$E\left(X-u \middle| X>u\right) = \frac{\sigma_u}{1-\xi} = \frac{\sigma_{u_0}+\xi\left(u-u_0\right)}{1-\xi}\ , \tag{7}$$

   where u_0 is extreme threshold value and σ_u is the scale parameter changes.

2. Chosen value threshold point when the plot began to form a linear pattern around the value of *u*.

D. Autocorrelation Function (ACF)

In this paper, the ACF was employed to detect if the extreme values larger than the threshold has a stochastic nature. Stochastic nature is random nature that can only be explained by a distribution [3]. Therefore, when the ACF is not significant or stationary, it is necessary to declustering data that take the extreme values of the highest in the range (*r*) determined in advance using the extremal index at (8) [4].

$$\vartheta = \begin{cases} \min\left\{1, \dfrac{2\left(\sum_{i=1}^{N-1} T_i\right)^2}{\left(N-1\right)\sum_{i=1}^{N-1} T_i^{\,2}}\right\} & \text{if } \max\left\{T_i : 1 \le i \le N\right\} \le 2 \\ \min\left\{1, \dfrac{2\left(\sum_{i=1}^{N-1}\left(T_i-1\right)\right)^2}{\left(N-1\right)\sum_{i=1}^{N-1}\left(T_i-1\right)\left(T_i-2\right)}\right\} & \text{if } \max\left\{T_i : 1 \le i \le N\right\} > 2 \end{cases} \tag{8}$$

E. Clustering the Location

Grouping of locations used to obtain shape parameter that estimated from stationary process. In this paper, if the slope values that are not stationary, then the groupings of locations with non-hierarchical clustering method, i.e. *k*-mean cluster, was employed. The number of groups was determined using the average value of silhouette coefficient calculated as in (9) [5]:

$$S\left(j\right) = \frac{\min\left(B\left(j,k\right)\right)-O\left(j\right)}{\max\left(O\left(j\right),\left(B\left(j,k\right)\right)\right)} \tag{9}$$

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where $B(j,k)$ denotes the average distance the members j with other members from different cluster and $O(j)$ describes the average distance between the member j to other members in the same cluster.

F. Bayesian Hierarchical Model (BHM)

The purpose of using BHM is to accommodate geographical and climatological information into the distribution of parameters and to update the parameters through the data that were known as a posterior distribution. The posterior distribution was determined by the following Bayes theorem.

$$z_{k,j,i} = c_{k,j} \times y_{k,j,i} \tag{10}$$

$$p\left(\boldsymbol{\theta}_1, \boldsymbol{\theta}_2 \middle| \mathbf{Z}(\vec{\mathbf{s}})\right) = p_1\left(\mathbf{Z}(\vec{\mathbf{s}}) \middle| \boldsymbol{\theta}_1\right) \times p_2\left(\boldsymbol{\theta}_1 \middle| \boldsymbol{\theta}_2\right) \times p_3\left(\boldsymbol{\theta}_2\right), \tag{11}$$

where $c_{k,j}$ is the constant transformation of resulting the cluster, $z_{k,j,i}$ is the result of the transformation in the cluster k, station j, and observation i. The p_1 is joint probability (or likelihood), p_2 is conditional prior distribution, and p_3 is prior distribution. The parameters in (11) are $\boldsymbol{\theta}_1 = [\phi, \xi]^{-1}$ and $\boldsymbol{\theta}_2 = [\alpha, \beta]^{-1}$ where ϕ, and ξ are scale and shape parameters in likelihood. The α and β are parameters in layer process.

III. DATA AND RESEARCH METHODOLOGY

This section discusses how to obtain estimates of the parameters and return level for the modeling of extreme precipitation events using BHM. The softwares used in this work are openBugs, Microsoft Excel, and R. The proposed method was applied to model rainfall data observed in six locations in Lamongan district, East Java, Indonesia.

A. Data and Pre-Processing

Pre-processing the data used to identify the missing value, outliers, and the observations that do not fit the requirement. The Microsoft Excel was used for pre-processing and open-source software R was used to calculate descriptive statistics such as histograms and normality plot, see [6].

TABLE 1. DATA STRUCTURE

Year	**Month**	**Station / Observation**	***S*$_1$**		***S*$_2$**		**…**	***S*$_{21}$**	
			***u*$_1$**	***v*$_1$**	***u*$_2$**	***v*$_2$**		***u*$_{21}$**	***v*$_{21}$**
1981	1	1	$x_{1,1}$		$x_{2,1}$		…	$x_{21,1}$	
1981	1	2	$x_{1,2}$		$x_{2,2}$		…	$x_{21,2}$	
⋮	⋮	⋮	⋮		⋮		⋱	⋮	
2013	12	108	$x_{1,n}$		$x_{2,n}$		…	$x_{21,n}$	

B. Sampling Extreme Value of the Data

1. Installing EVA packages in R used to analyze extreme value.
2. Activating extreme toolkit and create MRLP for a specified interval.
3. Identifying the mean residual life plot, find upper and lower bounds that are stable on the plot. Use the lower and upper limits of the modified parameters to make the plot of scale and shape parameters. Next, select the appropriate threshold values based on the results of the modified parameter plot.
4. Collecting extreme data above the threshold value.
5. The data obtained were tested with ACF plot. When there is no significant lag (stationary), then test the GPD using Anderson-Darling test [3]. If it is not stationary yet, then the declustering must be done.
6. A grouping station using the *k*-mean method and fill it with the value Silhouette as in (9) to obtain a proper number of the cluster.

C. Parameter Estimation with BHM

1. Compiling the Directed Acyclic Graph (DAG) to see the relationship between the data, parameters of the model, and the prior distribution using openBugs software [7].
2. Determining the initial value for each parameter to be estimated.

3. Determining prior for $\alpha_{\phi,i}, \beta_{\phi,0}, \beta_{\phi,1}$ and ξ as the parameters in layer process and likelihood.

D. *Application to Real Data*

The steps described before were applied to rainfall data in Lamongan district observed in seven locations. The data used is daily rainfall data span from 1981 to 2013. The first step done is determining the threshold value. Input the data into Microsoft Excel CSV (MC-DOS) and compile it into extreme toolkit already activated by typing "library (extRemes)" in R, as shown Figure 2. The MRLP, modified shape, scale and all about extreme value using extremes toolkit were produced as displayed in Figure 3.

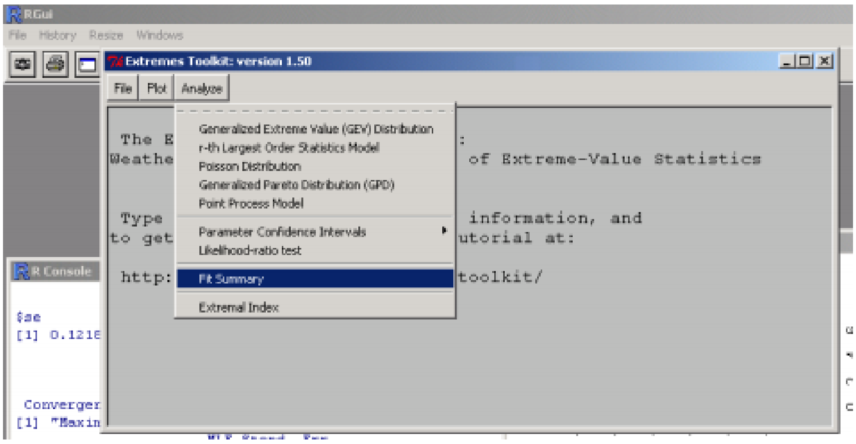


FIGURE 2. EXTREME TOOLKIT

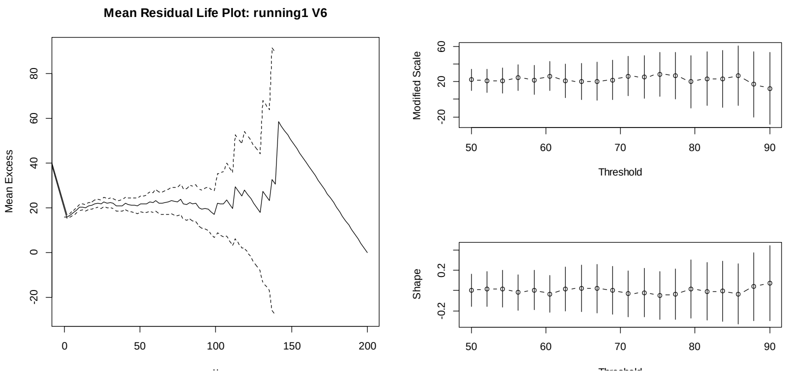
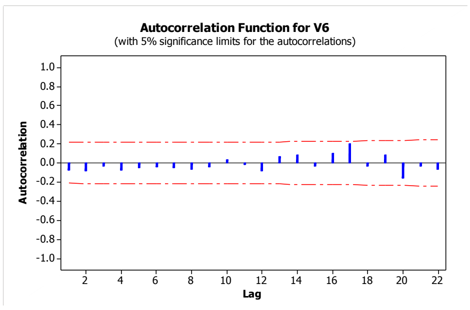


FIGURE 3. MRLP (LEFT) AND MODIFIED SCALE AND SHAPE PARAMETER PLOT (RIGHT)

As shown in Figure 3, the threshold limit (u) 60 began to show instability. Creating the ACF plot and conducting Anderson Darling's test (using EVA package in R) determine if the extreme data complies the distribution, i.e. GPD. If the test ACF insignificant and Anderson darling's test show that the GPD is satisfied, then the next step is doing declustering to take samples again. But, if the test does not meet the GPD, it is necessary to re-determine the threshold.



LOCATIONS	STATISTIC	P-VALUE	REMARKS
BABAT	0.5892	0.2637	NOT REJECT H0
BLAWI	0.7621	0.1226	NOT REJECT H0
KARANGBINANGUN	0.8546	0.1036	NOT REJECT H0
KEDUNGPRING	0.5692	0.2658	NOT REJECT H0
LAMONGAN	0.8615	0.0927	NOT REJECT H0
PANGKATREJO	0.6521	0.2234	NOT REJECT H0
SUKODADI	0.4848	0.3683	NOT REJECT H0

FIGURE 4. ACF PLOT (LEFT) AND THE RESULT OF ANDERSON DARLING TEST (RIGHT)

The ACF plot for Blawi station is displayed in Figure 3 (left). The plot shows that the extreme observations are independent. The Anderson Darling test with null hypothesis assumes that the extreme observation follows GPD. This test was employed using R software with command "gpdAd(y)" from EVA package. The observation in all locations follows GPD as P-values are larger than Type-I error $\alpha = 5\%$. The next step is estimating the scale and shape parameter by means of MLE. The results are summarized in Table 2.

TABLE 2. ESTIMATES OF PARAMETERS

LOCATIONS	Scale	Shape
BABAT	17.092	-0.120
BLAWI	23.370	-0.018
KARANGBINANGUN	27.025	-0.169
KEDUNGPRING	19.118	-0.034
LAMONGAN	17.955	-0.100
PANGKATREJO	20.205	-0.196
SUKODADI	14.010	-0.014

Once the parameters estimators were obtained, the next step is applying BHM (in this work using openBugs software) to the data. The conditional prior is updated by involving the location information as follows:

$$p_2\left(\boldsymbol{\theta}_1 \middle| \boldsymbol{\theta}_2\right) = \phi_s \sim MVN\left(\boldsymbol{\mu}_\phi, \boldsymbol{\Sigma}_\phi\right) \tag{12}$$

$$\mu_\phi = \alpha_0 + \alpha_1 lat_s + \alpha_2 long_s \tag{13}$$

$$\Sigma_\phi = \beta_1 \exp(-\beta_2 \left|s - s'\right|) \tag{14}$$

The mean μ_ϕ accommodate the location coordinate represented by latitude and longitude whereas the variance-covariance matrix is accommodate the distances among locations. The equation (13) and (14) are the mean and variance of the process layer (12) to find the posterior distribution in(11). Figure 5 shows the posterior density of scale parameters.

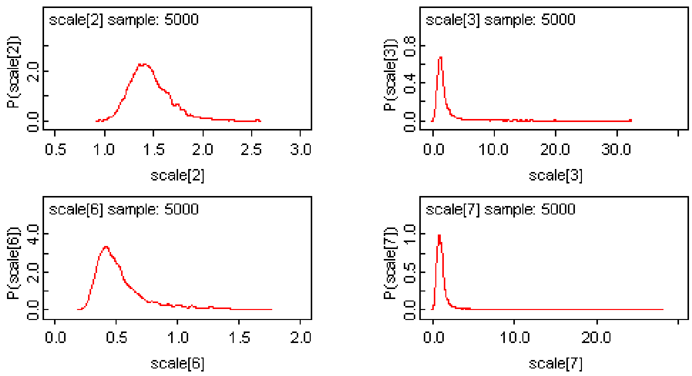


FIGURE 5. POSTERIOR DENSITY OF SCALE PARAMETERS

TABLE 3. PARAMETERS ESTIMATOR OBTAINED FROM BHM APPROACH

Param.	mean	Sd	MC_error	val2.5pc	median	val97.5pc	Start	sample
Beta1	2.185	7.399	0.37	0.08841	0.6363	17.42	4341	5000
Beta2	1.284	0.4611	0.01218	0.2938	1.362	1.924	4341	5000
alpha0	-0.7119	5.03	0.4109	-16.95	-0.009851	5.896	4341	5000
alpha1	-0.01985	0.1014	0.00651	-0.2826	-0.003282	0.1807	4341	5000
alpha2	-0.4897	1.681	0.1124	-5.003	-0.1136	2.147	4341	5000
scale[1]	1.37	0.2343	0.005997	1.016	1.335	1.908	4341	5000
scale[2]	1.458	0.1931	0.004915	1.144	1.434	1.897	4341	5000
scale[3]	1.674	1.434	0.03363	0.4144	1.35	4.921	4341	5000
scale[4]	0.9598	0.2706	0.006348	0.5739	0.9183	1.604	4341	5000

scale[5]	1.512	1.822	0.03425	0.3728	1.263	3.96	4341	5000
scale[6]	0.524	0.2047	0.01077	0.2936	0.4703	1.12	4341	5000
scale[7]	1.016	0.7888	0.01229	0.2457	0.8921	2.662	4341	5000

Table 3 shows that the parameters α_0, α_1 and α_2 are not significant because there is zero value within credible interval while the others are significant. The significant parameters can be used in the model. Thus, it can be concluded that the latitude and longitude variable are suitable for spatial models but not suitable as an effect of predictor models. The model of layer process with μ_ϕ equal to zero is expressed in (15):

$$p_2\left(\boldsymbol{\theta_1}\middle|\boldsymbol{\theta_2}\right) = \phi_S \sim MVN\left(0, \boldsymbol{\Sigma}_\phi\right) \tag{15}$$

Having obtained a significant model, the next step is to estimate the scale and shape parameter as reported in Table 4.

TABLE 4. ESTIMATOR OF SCALE PARAMETERS AND RETURN LEVEL OBTAINED FROM BHM APPROACH

LOCATIONS	n (x>u)	u	scale	Shape	Pr(X>u)	Return Level (Years) 5	20	30	40	100
BABAT	51	85	24.013	-0.20	0.01	130.29	148.50	152.95	155.89	164.22
BLAWI	87	60	14.635	-0.20	0.01	92.24	102.23	104.66	106.28	110.84
KARANGBINANGUN	21	80	19.678	-0.20	0.00	105.17	122.96	127.31	130.18	138.33
KEDUNGPRING	45	72	34.463	-0.20	0.01	134.26	161.06	167.60	171.93	184.19
LAMONGAN	33	67	14.398	-0.20	0.00	90.06	101.96	104.87	106.79	112.24
PANGKATREJO	50	65	13.537	-0.20	0.01	90.36	100.67	103.18	104.85	109.57
SUKODADI	45	68	18.509	-0.20	0.01	101.44	115.83	119.34	121.67	128.25

The predictions of return level for 5, 20, 30, 40 and 100 years were summarized in Table 4. In 2018 (five years return level), the predicted heaviest rainfall daily in Babat Station is 130.29 mm. The return level increased for twenty years become 148.50 mm continuously increased for longer periods. This also happened in other six locations.

IV. CONCLUSION AND SUGGESTIONS

This paper showed the procedure for obtaining estimates of GPD parameters and calculating the return level using a Bayesian Hierarchical models applied to rainfall data in Lamongan. The location information represented by longitude and latitude variable were considered as an input variable in the model. The empirical result shows that these two variables are not significant in the mean model. The return level got higher for longer periods in all stations. These empirical findings suggest that the future research should explore other climatology variables as input in the model.

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Propensity Score Stratification Analysis using Logistic Regression for Observational Studies in Diabetes Mellitus Cases

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Abstract**—** Observational studies are the basis of epidemiological research to draw the conclusions of the effects or a response treatment. In general, a randomized trial is required in order to meet the assumption of independence to minimize the bias effects. However in an observational study, particularly in medical field, randomization not able to implement because conduces in doubtful treatment effects estimation. Propensity score is the conditional probability to get certain treatments involving the observed covariates. This method is used to reduce bias in the estimation of the impact of treatment on observational data for their confounding factors. If treatment is binary, then the logistic regression model is one estimated of propensity score because of easiness in terms of estimation and interpretation. In the analysis of observational studies, propensity score stratification (PSS) has proven to be one of methods to adjust the unbalanced covariate for the purposes of causal inference. The data used in this study is the medical records of patients DM in X hospital about the factors that influence the type of diabetes mellitus. In this study PSS used in diabetes mellitus cases to reduce bias due to confounding factors, so that can be known the factors affect the type of diabetes mellitus with obesity as confounding factors. The results of PSS analysis is known that the variables directly influence the type of DM are obesity, age, gender and variable does not directly influence the type of DM are genetic variable, sport activities and dietary habit of patients DM.

Keywords: *observational studies, confounding, propensity score stratification, diabetes melitus*

I. INTRODUCTION

The attention of non-communicable diseases is increasing currently. From ten leading causes of death, two of them are non-communicable diseases. Diabetes mellitus (DM) is a non-communicable disease with high prevalence. International Diabetes Federation (IDF) stated that people with diabetes mellitus figure reached 382 million people of the world in 2013. It is estimated as 592 million in 2035. In Indonesia, people with diabetes mellitus has reached 8.4 million in 2000 and is estimated to be approximately 21.3 million in 2030. Because of high number of patients, it makes Indonesia ranks fourth after the United States, India and China [1].

According to the results of Indonesia Basic Health Research (RISKESDAS) in 2013, an increase in the prevalence of Indonesia's diabetes mellitus in 2007 was 1.1% to 2.1% in 2013. The results of the analysis of the Diabetes Mellitus prevalence's picture based on a doctor's diagnosis and symptoms increase with age. It began with age $\geq$ 65 years old of decline. The prevalence of diabetes in women is 1.7% while men have 1.4%. Based on its territory, the prevalence of urban areas (2.0%) is higher than in rural areas 1.0% [2].

Diabetes mellitus (DM) is a chronic metabolic disorder due to the pancreas does not produce enough insulin or the body can not use the insulin that is produced effectively. Insulin is a hormone that regulates blood glucose levels. Diabetes mellitus is classified into type 1 diabetes, which is known as insulin-dependent or childhood-onset diabetes, characterized by a lack of insulin production. Type 2 diabetes, known as non-insulin-dependent or adult-onset diabetes, caused by the body's inability to use insulin effectively which then lead to overweight and lack of physical activity [3].

Increasing the number of people with diabetes are mostly caused by the interaction between the factors of genetic susceptibility and exposure to the environment, such as changes in lifestyle and physical activity often leading to obesity. It is a risk factor for the onset of DM [4]. Therefore, diabetes mellitus type 2 is often also called diabetic lifestyle for causes not only because of heredity, but also environmental factors include age, obesity, insulin resistance, food, physical activity, and unhealthy play roles in the occurrence of diabetes [5].

Research on the incidence of diabetes mellitus (DM) has been done in large quantities. For example Wicaksono [4] investigated the factors associated with the occurrence of diabetes mellitus (DM) type II using descriptive analysis and logistic regression. Trisnawati et al. [6] studied the risk factors of type 2 DM outpatients using the McNemar test and logistic regression and Indriyani et al. [7] studied the effect of physical exercise to decreased levels of blood sugar of patients with type 2 DM using the t test with the one group pretest-posttest study design.

The above researches mostly used descriptive analysis and logistic regression without considering the possibility of a powerful combination of factors affecting diabetes mellitus (DM). In fact, as explained previously that the combination of these factors led to the existence of confounding variables that lead to obtain inaccurate conclusions.

Some previous studies have tried to discuss confounding factors randomly, but in the case of health sector, it can not be done. But how the confounding variables included in the factors studied. Therefore, we need a method that can handle the effects of bias caused by these confounding factors. One method that can handle confounding is the propensity score method. it was first introduced by Rosenbaum and Rubin in 1983. The propensity score is defined as the conditional probability to receive interventions based on those characteristics before the intervention [8]. This method is a statistical adjustment that can be used to analyze data from non-experimental research design where design giving treatment through randomization to treatment or control group is not possible. Researchers can use the propensity score for statistical balance or equalize the group of research subjects to reduce bias due to the provision of treatment which is not random.

One method of propensity score that is proven to reduce bias due to confounding effects is the propensity score stratification method. This method focuses on the division of classes / strata based on the estimated value of propensity score. The division of classes / strata aims to balance the distribution between treatment and control groups so that estimate of average treatment effect more accurate.

Several studies of the model used to estimate the value of propensity score, they are McCaffrey et al.[9] which used a model of generalized boosted, McCandless et al. [10] used Bayesian, and Littnerova et al.[11] used logistic regression to estimate propensity score. Of all the study, estimated by logistic regression simpler and easier in interpretation, particular to the category data used.

Based on the description above, the aim of research in this study are to get an estimation of average treatment effect and binary logistic regression model based on the propensity score that shows the factors affecting the type of DM in patients treated in X hospital district after being controlled by confounding variables of obese patients' status.

II. THEORY

2.1 Logistic Regression Model

According to Hosmer & Lemeshow [12] binary logistic model is the logarithm of odds ratio of occurrence of success (π) and probability of occurrence of fail ($1 - \pi$) . The specific form of the logistic regression model with *p* predictor variables expressed in equation (2.1)

$$\pi(\mathbf{x}) = \frac{\exp\left(\beta_0 + \sum_{m=1}^{p} \beta_m x_m\right)}{1 + \exp\left(\beta_0 + \sum_{m=1}^{p} \beta_m x_m\right)} \tag{2.1}$$

Form of simplification of the equation above, then used a logit transformation of the form below.

$$g(\mathbf{x}) = \ln\left(\frac{\pi(\mathbf{x})}{1-\pi(\mathbf{x})}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p = \mathbf{x}^T \boldsymbol{\beta} \tag{2.2}$$

with $\pi(\mathbf{x})$ is the probability of success, $1-\pi(\mathbf{x})$ is probability of fail event, β_m are the parameters of the linear function with the predictor variables $m = 1, 2, \ldots, p$.

2.2 Propensity Score

Propensity score analysis introduced by Rosenbaum and Rubin 1983 in the journal entitled "The central role of the propensity score in observational studies for causal effects". Propensity score analysis is a statistical method that rapidly evolving innovative and useful for evaluating treatment effects when using observational data [13]. Rosenbaum and Rubin [8] define the propensity score for observation i (i = 1, ..., n) as the conditional probability of a specific treatment (Z_i = 1) versus non-treatment (Z_i = 0) based on the characteristics of the covariates $\mathbf{x}_i$ observed.

According to Guo & Fraser [13] the value of propensity score is defined as follows.

$$e(\mathbf{x}_i) = P(Z_i = 1 \mid X_i = x_i) \tag{2.3}$$

According to Littnerova et al.[11] propensity score using a logistic regression model, the response variable is a binary where to treatment and to the control unit with the following model.

$$e(\mathbf{x}_i) = \mathrm{P}\left(Z_i = 1 \middle| X_i = x_i\right) = \frac{\exp\left(\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip}\right)}{1 + \exp\left(\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip}\right)} \tag{2.4}$$

with β_0 is a constant, $\beta_1, \beta_2, \cdots, \beta_p$ the regression coefficients and $x_1, x_2, \cdots, x_p$ are covariate variables.

According to Cochran & Rubin (1973) in the Pan & Bai [14] measures the bias is reduced for each covariate can use equation (2.11)

$$PBR = \frac{B_{\text{before PS}} - B_{\text{after PS}}}{B_{\text{before PS}}} \text{x}100\% \tag{2.5}$$

and

$$B = p_1(x_p) - p_0(x_p) \tag{2.6}$$

with PBR is Percent Bias Reduction, B is an average difference of the treatment group and the control group for each covariate , $p_1(x_p)$ and $p_0(x_p)$ are proportion of covariates for the treatment group and the control group, $B_{\text{before PS}}$ and $B_{\text{after PS}}$ are represents the difference between the average treatment and control group before propensity score and after propensity score.

2.3 Propensity Score Stratification

Propensity Score Stratification (PSS) is a procedure of classifying subjects into classes based on the estimated propensity score . Subjects are sorted by the estimated propensity score (Austin, 2011). Cochrane (1968) showed that the five sub-class is enough to reduce 90 % of bias with a single covariate [15]. Imbens [16] declared the entire bias under unconfounded associated with the propensity score, it indicates that under the normality used 5 strata change is largely biased with all covariates.

According to Yanovitzky, Zanutto, and Hornik [17] general steps of propensity score analysis are described as follows

1. Choose a covariate as a confounder for the estimation of propensity score. The election process can confounder based on theory and empirical evidence about the relationship between variables.
2. Estimated value of propensity score.
3. Divide the strata based on the propensity score.
4. Check the balance of covariates between the treatment group and the non-treatment.
5. Calculate the effect of confounders.

One way to assess the quality of the propensity score stratification by comparing a variety of statistics such as mean, median, variance, t-test statistics, chi-square test or Kolmogorov-Smirnov (KS) test on each covariate [15]. In this study, KS and chi-square used for testing difference distribution between the treatment group and the control group.

2.4 *Diabetes Mellitus*

Diabetes mellitus is metabolic diseases which is a collection of symptoms that arise in a person because increase in blood glucose levels above normal values . The disease is caused by disorders of the metabolism of glucose due to a deficiency of insulin both absolute and relative terms . There are two types of diabetes mellitus. The first type of DM is type 1, that usually acquired since childhood and results from the pancreas failure to produce enough insulin. The second type of DM is type 2, that usually acquired an adult and condition in which cells fail to respond to insulin. According Poretsky [18] factors that affect type 1 diabetes is a genetic, autoimmune, age, race and ethnicity, gender, and environmental factors such as viral infections, diet / nutrition, stress. In addition, according Gungor, Hannon, Libman, Bacha, & Arslanian [19] factors affecting the type 2 diabetes are genetic, age, gender and environmental factors such as diet, obesity, sports activities.

III. METHODOLOGY

The method used in this study is propensity score stratification (PSS) method to find the factors that influence the type of diabetes mellitus (DM) with obesity status of patients as a confounding factor. The data used is secondary data from medical records of patients (DM) at Hospital X in 2013. The number of respondents are 497 patients. The Patients consist of patients with type 1 of DM (42 patients) and patients with type 2 DM (455 patients). The response variable is the type of DM and predictor variables are genetic, age, gender, dietary habit, sport activities and obesity. The stages of research process can be seen in Figure 1 below.

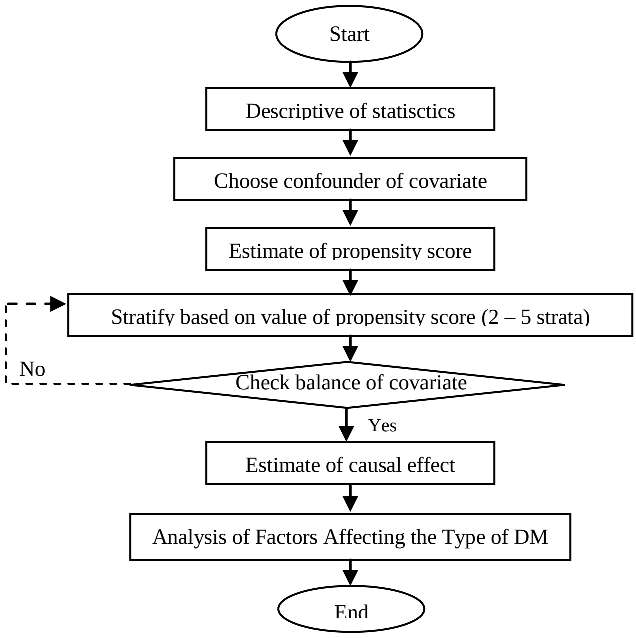


FIGURE 1. STAGES OF RESEARCH PROCESS

IV. RESULT AND DISCUSSION

4.1 Descriptive of Statistics

Descriptive of statistics is an early stage of data exploration to get a general overview of the research data. Characteristics of respondents can be seen from the descriptive of each variables shown in Table 2.

TABLE 1. DESCRIPTIVE ANALYSIS OF COVARIATE

Covariate	**Status Obesity**		**%**	**Type of DM**		**%**
	Obesity	**No Obesity**		**Type 1**	**Type 2**	
Genetic						
- Have genetic	379	31	82,49	0	410	82,49
- Have not genetic	52	35	27,51	42	45	27,51
Age	431	66	-	42	455	-
Gender						
- Male	192	32	45,07	24	200	45,07
- Female	239	34	54,93	18	255	54,93
Dietary habit						

- Meet	29	63	18,51	25	67	18,51
- No Meet	402	3	81,49	17	388	81,49
Sport Activities						
- Active	29	65	18,91	27	67	18,91
- Less Active	402	1	81,09	15	388	81,09

Based on the table 2 can be shown that to 82.49 % patients have genetics DM, 81.49 % patients have dietary habit (no meet) and 81.09 % patients less active in sports activities. In addition, it was known that the number of female patients (54.93%) are greater than male patients (45.07 %). From table 2 can shown too that the most patients have obesity and type 2 diabetes are genetics diabetes, female gender, dietary habit (no meet) and patients who has less active exercise in sport activities.

4.2 Propensity Score Stratification Analysis

4.2.1 Choose a covariate as a confounder

The first step in the propensity score analysis is to choose covariate as a confounder variable. The determination of confounding variables based on the theory and proven with empirical evidence like the relationship between variables. Testing relationship between variables used chi-square test. Based on research conducted by Betteng, et al.[5] known that obesity has a relationship with genetic factors, dysfunction of the brain, dietary habit is over, less activities of sport, emotional, environmental factors, social factors and lifestyle. Therefore, this relationship will be proven by empirical evidence using chi-square test . Results of testing the correlation between covariates with obesity variables are shown in Table 2.

TABLE 2. TESTING RESULTS CORRELATION BETWEEN COVARIATES WITH OBESITY

Variable	χ^2	Df	P-*value*	Decision
$x_4 * x_1$	66,513	1	0,000	Reject H_0
$x_4 * x_2$	2,047	3	0,563	Failed to reject H_0
$x_4 * x_3$	0,358	1	0,549	Failed to reject H_0
$x_4 * x_5$	298,701	1	0,000	Reject H_0
$x_4 * x_6$	314,208	1	0,000	Reject H_0

Based on Table 2 can be shown that genetic, diet and active sports activities has significant influence to obesity variables. Meanwhile age and gender has not significant influence to obesity. Based on those results, so it is a proof that obesity variable is the most variable that associated with other variables. Therefore, obesity variable is selected as confounding variable Z with parameter θ.

4.2.2 Estimating the Propensity Scores

In this study the propensity score estimated by logistic regression. There are five variables will be estimated, their variables are genetic, age, gender, dietary habit and sports activities. The result of parameter is shown in Table 3.

TABLE 3. PARAMETER ESTIMATION FOR THE RELATIONSHIP OBESITY (Z) WITH COVARIAT (X)

Covariate	Parameter (β)	SE	p-value	OR	OR (95% CI)
Intercept	3.8357	1.4479	0.0081	33.9019	1.4069 - 16.8948
Genetic	2.3211	0.6562	0.0004**	10.7902	2.9338 - 39.6853
Age	0.0118	0.0192	0.5397	1.0174	0.9706 - 1.0665
Gender	0.1722	0.4500	0.7020	0.9835	0.3872 - 2.4980
Dietary habit	-1.8721	1.3741	0.1731*	0.1682	0.0114 - 2.49269
Sport Activities	-5.2426	1.6029	0.0011**	0.0057	0.0002 - 0.1328

(*) significant at α = 20%, (*) significant at α = 0,1%,

Based on Table 3 can be shown that the variables have significant influence to obesity at significance level (α = 0.1 %) are variable genetic with p-value = 0.000 and sport activities with p-value = 0.0011, while dietary habit variable is significance at α = 20%. It is indicates that the status of obesity patients DM was determined by genetic factors, dietary habit, and sports activities of patient DM.

From the estimation parameters are shown in Table 3, it can be obtained the value of propensity score below.

$$e(\mathbf{x}_i) = \frac{\exp\left(3,84 + 2,32\, Gen(1) + 0,01\, Age + 0,17\, Gndr(1) - 1,87\, DH(1) - 5,24\, SA(1)\right)}{1 + \exp\left(3,84 + 2,32\, Gen(1) + 0,01\, Age + 0,17\, Gndr(1) - 1,87\, DH(1) - 5,24\, SA(1)\right)} \qquad (2.7)$$

Equation (2.7) illustrates that each age of patients DM is increase one year, so the odds of obesity will increase by 1,017 times. The probability of someone who have genetic DM become obesity is 10.79 times greater than someone who does not have a genetic history of diabetes, the probability of a women having obesity is 0.984 times greater than a men , the probability of someone a healthy diet having obesity is 0,168 times than someone whose diets are not healthy and active sports person's probabilitys having obesity is 0.006 times that of someone who rarely exercise.

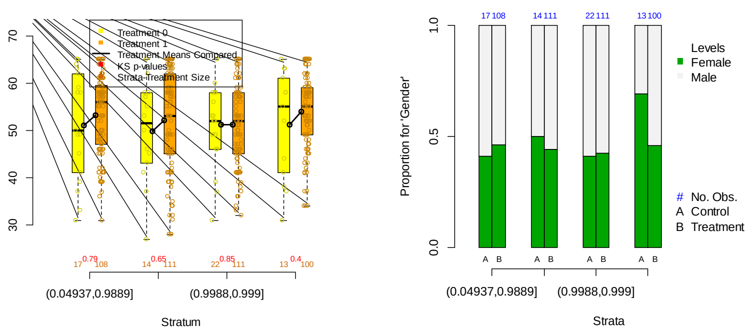
4.2.3 Stratify and Balance the Propensity Scores

After estimating the propensity scores, the next step is subclassified them into different strata. The formation of this stratum aims to balance the treatment and control groups so that estimates of treatment effect is not biased. The number of balanced propensity score strata depends on the number of observations in the data set. Table 4 shows the test of covariate balance after stratification based on the quintiles of the propensity score. Five of the covariates were included in the final propensity score model used for stratification. The initial imbalances were measured by chi-square test for categorical data (genetic, gender, dietary habit and sport activities) and Kolmogorov-Smirnov test for continuous data (age) comparing the obesity and no obesity groups.

TABLE 4. TEST OF STRATA BALANCE

Strata	**n**	**Chi-Square Tests for Balance**				**KS-Test for Balance**
		Genetic	**Gender**	**Dietary Habit**	**Sport Activities**	**Age**
1	126	0,058	0,800	0,954	0,525	0,790
2	125	0,052	0,780	0,525	1,000	0,650
3	133	0,055	1,000	1,000	0,475	0,850
4	113	0,062	0,150	1,000	1,000	0,400

Based on Table 4 can be shown that after testing using chi-square test for categorical data, their covariates such as genetic, gender, dietary habit and sports activities shows that obesity and no obesity have a balance at all strata. Similarly, for the covariates of age which was tested by Kolmogorov-Smirnov (KS) test. Covariate testing balance is supported by Figure 2. Figure 2 represents a picture which shows a balance between the obesity and no obesity for categorical data (gender) and continuous data (age). So that the analysis can be continued to the next step, the step is estimate average treatment effect or average effect of obesity on the type of DM. Pattern of balance can be seen in Figure 2 below.



(A) (B)

FIGURE 2. COVARIATE OF PROPENSITY SCORE IN BALANCE STRATA (A) AGE, (B) GENDER

4.2.4 Estimating the Causal Effect

Propensity score is an ideal method to see the effect of treatment on observational studies. This method can reduce bias effect because differences distribution of covariate between treatment and control groups. Therefore, before the estimated treatment effects, covariates between the treatment and control groups should be balanced. Because in the previous step has been obtained strata with covariates were balanced, then the next step is estimation of the treatment effect. In this case estimate of the effect of obesity on the type of DM. The estimation results for before and after stratification shown in Table 5.

TABLE 5. RESULT OF ESTIMATION AVERAGE TREATMENT EFFECT (ATE)

ODD RATIO FOR ATE					
BEFORE STRATIFICATION			AFTER STRATIFICATION		
UNADJUSTED	SE UNADJUSTED	95% CI STRATA	ADJUSTED	SE ADJUSTED	95% CI STRATA
16,859	0,3583	8,353 – 34,027	7,065	0,516	2,570 – 19,424

Table 5 shows the result for estimated effect of obesity on the type of DM before and after stratification. From table 5 obtained an average yield effects of obesity on the type of DM before stratification (unadjusted) is 16.859 with a standard error of 0.3585 and after stratification (adjusted) the effect of obesity is 7.065 with the standard error of 0.516. Propensity method also provides estimates of 95% confidence interval between 2.570 and 19.424. This confidence interval shown the difference average between the treatment group and the control of obesity is significant, or in other words, obesity significantly influence the type of DM with the effect is 7.065.

4.3 Analysis of Factors Affecting the Type of DM

After the estimation of treatment effects (obesity) was known then the next step is to determine the relationship of covariates with type of DM.

TABLE 6. PARAMETER ESTIMATION FOR THE RELATIONSHIP BETWEEN TYPE OF DM (Y) WITH COVARIAT (X)

Covariate	Parameter $\left(\boldsymbol{\beta}^*\right)$	SE	p-value	OR	OR (95% CI)
Intercept	2.8368	1.4367	0.0483	17.0611	1.0211 – 285,0692
Genetic (1)	21.2478	1375.7492	0.9877	1689671554	-
Age	-0.0448	0.0277	0.1059*	0.9562	0,9056 – 1,0095
Gender(1)	0.7892	0.5213	0.1301*	2.2016	0,7925 – 6,1162
Dietary habit(1)	-0.5024	1.3191	0.7033	0.6051	0,0456 – 8,0288
Sport Activities(1)	-1.3926	1.2916	0.2810	0.2484	0,0198 – 3,1234

(*) significant at $\alpha = 20\%$

Based on Table 6 can be shown that the variables significantly influence to the type of DM at significance level α = 20 % are variable age with *p*-value = 0.106 and gender with *p*-value = 0.1301. Based on the table 6 known that the type of DM patients was influenced by the age and gender of patients DM, or age and gender variable are variables that directly influence the type of DM patients.

From the estimation parameters are shown in Table 6, can be obtained logistic regression model covariates significant relationship between the type of DM as below.

$$\pi\left(\mathbf{x}_i\right)=\frac{\exp\left(2,837-0,045\,Age+0,789\,Gender\left(1\right)\right)}{1+\exp\left(2,837-0,045\,Age+0,789\,Gender\left(1\right)\right)} \tag{2.8}$$

Equation (2.8) illustrates that any increase 1 year of age patients DM, the odds for type of DM decreased by 0.956 times and the probability for women having type 2 of DM is 2,202 times greater than men.

V. CONCLUSSION

Propensity score is a good method to see the effect of treatment on observational studies, particularly data with different background covariates. The different of covariate can make inaccurate conclusions. Propensity score stratification can balance the covariates between the treatment and control groups so that can reduce bias due to confounding effects. Analysis of propensity score stratification shown that the variables influence obesity are genetic variable, sports activities and dietary habit of patients and the effect of obesity on the type of DM after stratification is amount 7.065 with a standard error of 0.516. In addition, the variables that directly influence the type of DM patients are obesity, age, gender and variable that does not directly affect the type of DM patients are genetic variable, sport activities and dietary habit of patients DM with the obesity as confounding factors if modeled by logistic regression.

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Performance of W-AMOEBA and W-Contiguity matrices in Spatial Lag Model

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Abstract - The paper discussed a parameter estimation methods and construction of spatial weighted matrix in the modeling of the spatial data. Many options can be used to construct a spatial weighted matrix, one of the them is a matrix AMOEBA (W_AMOEBA). Here, we studied about the W_AMOEBA and Contiguity matrix spatial lag model (SLM) using two step least square (two-SLS) . For simulation, we used human development index (HDI) data. The results showed that the relative W_AMOEBA is more accurate than W-contiguity.

Keyword: Spatial modelling, Two-SLS, W_AMOEBA, W_Contiguity.
2010 Mathematics Subject Classification: Primary 62H10 and Secondary 60E05

1. INTRODUCTION

1.1 Background

Many authors have studied about spatial models such as Folmer and Oud (2008), Liu, et.al (2011a, 2011b) and Aldstadt and Getis, 2006. They discussed W-structural equation model (W_SEM) and W-an multidirectional optimum ecotope base algorithm (W_AMOEBA), respectively.

Spatial data is a stochastic process which have more than two indexes. There were researchers have already studied modeling of spatial data in theoretical and application. The objective of spatial data analysis is to determine the pattern of the spatial data. The spatial data are usually dependent each others. It is called spatial autocorrelation. In the model of spatial data, the autocorrelation is represented by spatial weighted matrix.

Human development index (HDI) is one of the indicators for seeing development of regions (area). Here, we face problem on correlation among adjacent areas (neighbored area).. To accommodate dependence among those areas, the spatial weighted matrix is used. Here, there are several ways to construct a spatial weighted matrix such as contiguity, inverse distance contiguity, and *k*-nearest neighbor (Anselin,1995, Stakhovych and Bijmolt, 2008), ***W-SEM*** (Folmer and Oud, 2008, Liu, et.al 2011a, 2011b) and ***W-AMOEBA*** (Aldstadt and Getis, 2006).

1.2. Objectives

The objective of this study is to evaluate of W-AMOEBA and W-contiguity on spatial lag model (SLM) in the case of the HDI.

2. RESEARCH METODOLOGY

2.1 Spatial Lag Model

In linear regression model, spatial dependence can be incorporated in two distinct way: as an additional regression in the form of a spatially lag dependence (***Wy***) or in the error structure. Spatial lag model (SLM) (or spatial autoregressive, SAR) is appropriate when the focus of interest is the assessment of existence and strength of spatial interaction (Anselin, 1995). Generally, a spatial lag model or spatial autoregressive model is given as

$$\boldsymbol{y} = \boldsymbol{\rho W y} + \boldsymbol{X\beta} + \boldsymbol{\varepsilon}, \tag{1}$$

where
$\boldsymbol{y}$ = vector of dependent variable
$\boldsymbol{X}$ = matrix of independent variable
$\boldsymbol{W} =$ spatial weighted matrix
ρ = spatial autoregressive coefficient
$\boldsymbol{\beta}$ = vector of parameter
$\boldsymbol{\varepsilon}$ = vector of error terms

Here, the spatial autoregressive coefficient (ρ) is assumed to stationary when $|\rho| < 1$.

2. 2. W Contiguity

Spatial weighted matrix is an essential component of the spatial model. Generally, spatial weight matrix that used to spatial model based on contiguous area (geographically) and inverse distances. Due to of the geographical proximity, the spatial weighted matrix is created as follows. Let $W = \{w_{ij}\}$ $i, j = 1,2, ..., n$, is contiguities matrix with w_{ij} represents the value of spatial unit i and j, and here we also present spatially located at some positions see Figure 1.

(a)

A	*B*	*C*
D	***F***	*G*
H	*I*	*J*

(b) *Rook*

	B	
D	***F***	*G*
	I	

(c) *bishop*

A		*C*
	F	
H		*J*

(d) *queen*

A	*B*	*C*
D	***F***	*G*
H	*I*	*J*

Figure 1 Contiguity matrices *rook (b), bishop (c)* and *queen (d)* of spatial unit on (*a*) that close to ***F***.

Inverse distance matrix is another type of spatial weighted matrix that often used in spatial modeling. Generally, type of distance that use in constructing spatial weight matrix is the Euclidean distance. For two coordinate spatial units i and j, (x_i, y_i) *and* (x_j, y_j), the inverse distance is expressed as

$$W_{ij}=\{1/d_{ij}\}, \text{ where } d_{ij} = \sqrt{\left(x_i - x_j\right)^2 + \left(x_i - x_j\right)^2}.$$

2.3 W_AMOEBA

A multidirectional optimum ecotope-based algorithm (AMOEBA) is one of an illustration on the spatial weighted matrix. The AMOEBA is usually depended on the behavior data. Furthermore, W_AMOEBA are designed to clustering spatial units and construct spatial weighted matrix on empirical data (Alsdstadt and Getis, 2006). Later, the W_AMOEBA is defined as combination between the geographic and behavior data (Stakhovych and Bijmolt 2008; Alsdstadt and Getis, 2006). Here, the W_AMOBA has a special procedure that developed by Aldstadt and Getis (2004). Note that in the W_AMOEBA, the local Getis statistic is used to divide into high and low spatial units.

Let an area is divided for n regions, i=1,2,...,n, $G_i = \frac{\sum_{j \neq i} w_{ij} x_j}{\sum_{j \neq i} x_j}$ is local Getis statistic, and $G_i^* = \frac{G_i - E(G_i)}{\sqrt{VarG_i}}$ be standard local Getis statistic. Let $G_i^*(k)$ is the value of statistics G_i^* for link k, The AMOEBA algorithm (Altstadt and Getis, 2006) is given as follows.

At the outset of the AMOEBA procedure, we compute $G_i^*(0)$, here the ecotope consist of just the i^{th} unit ($k = 0$). The value of $G_i^*(0)$ is greater than zero, it indicates that the value at location i is larger than mean of all unit, and otherwise. For k=1, $G_i^*(1)$, this value shows that for each areas/region that contains units i and all combinations of its contiguous are neighbors. If $G_i^*(0)$ is greater than the combination that maximizes $G_i^*(1)$, it be new high ecotope. If $G_i^*(0)$ is less than the combination that maximizes $G_i^*(1)$, it be new low ecotope. At each succeeding step, for the contiguous units include in the ecotope, they are then not considered. Likewise, units included in the ecotope remain in the ecotope. Subsequent steps evaluate all combinations of contiguous neighbors and new members of the ecotope are then identified. This process continues for *k*, *k = 2, 3, ..., max.* The final ecotope (k_{max}) is identified when the addition of any set of contiguous units fail to increase the absolute value of the statistics G^*_i. The results of the AMOEBA procedure are then used to construct ***W*** using several steps as follow

.

(a) when $k_{maks} > 1$,

$W_{ij} =$

$$w_{ij} = \begin{cases} \dfrac{\{P[z \le G_i^*(k_{maks})] - P[z \le G_i^*(k_j)]\}}{\{P[z \le G_i^*(k_{maks})] - P[z \le G_i^*(0)]\}}, 0 < k_j \\ 0 \qquad , \quad \text{untuk } k_j \text{ se} \end{cases}$$

0 , otherwise

(b) when $k_{max} = 1$, $w_{ij} = 1$ for $k_j=1$ and 0 otherwise.

(c) When $k_{max} = 0$, $w_{ij} = 0$ for all k

where k_j is *link* that connecting between *i* and *j* in ecotope.

2.4. Instruments Variables Method

The simple method of estimation parameter in regression models is ordinary least square (OLS). One of the advantages of the OLS is robust to error distribution. Here, the error and exogenous variable must be independent. If the model containing endogenous variable and residual distribution is not known, we need other estimation methods, one of them is the method of instrumental variables of two step least square (two-SLS) (Verbeek, 2008).

We see that SLM contains endogenous variable (***Wy***), so the OLS can't be used to estimate model parameters. To overcome this problem, we must used other method. Instrument variable method or two-stage method is one of methods that can be used to solve endogenous problem in spatial model. The principle of the instrument variable method is to use new variable that correlated to the response variable, but uncorrelated with the residual.

3. RESULTS

3.1 Violation OLS on SLM

Let $Z = (\boldsymbol{Wy}\ \ \boldsymbol{X})$, and $\boldsymbol{\theta} = \begin{pmatrix} \rho \\ \boldsymbol{\beta} \end{pmatrix}$, so the SLM model can be written as

$$\boldsymbol{y} = \boldsymbol{Z\theta} + \boldsymbol{\varepsilon}, \tag{2}$$

where the assumptions of the OLS method are $\boldsymbol{E(Z'\varepsilon)} = 0$ and Cov(.$\boldsymbol{\varepsilon, Z}) = \boldsymbol{0}$. Due to Z consists of *Wy* and *X* variables, so the OLS is fail to estimate parameter model on the SLM. This is due to the assumption is violate.

The assumption of the OLS $\boldsymbol{E(Z'\varepsilon)} = 0,$ we then have $\boldsymbol{E(W'\varepsilon)} = 0$ and $\boldsymbol{E(X'\varepsilon)} = 0$.

Here,

$$\boldsymbol{Cov(\varepsilon, Wy)} = \boldsymbol{Cov(\varepsilon, W(\rho Wy + X\beta + \varepsilon))}$$

where Cov $(\varepsilon, Wy) \neq 0$ because Wy = W(y+Xβ+ε) = Wy+WXβ+Wε), so Cov (ε,Wy)=Cov(ε, Wy+WXβ+Wε) $\neq 0$. Therefore the moment, i.e $\boldsymbol{E(Z'\varepsilon)} = 0$, is violate.

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3.2 Method of Variable Instrument

The method of variable instrument (*IV*) is also called a two-stage OLS method. In this method, the endogenous variable is instrumented by new variables, but in SLM method, the endogenous variable, ***Wy,*** is instrumented with new variable that correlated to response, but uncorrelated to the error terms.

Due to SLM model, let, $Z = (\boldsymbol{Wy}\ \ \boldsymbol{X})$ and $\boldsymbol{\theta} = \begin{pmatrix} \rho \\ \boldsymbol{\beta} \end{pmatrix}$, so (1) can be expressed as (2). To estimate parameter $\boldsymbol{\theta}$, we use ***IV method*** as follows:

(1) determine instrument variable **H**,

$$E(\boldsymbol{\varepsilon} \mid \mathbf{H}) = 0, Cov(\mathbf{Z}, \mathbf{H}) \neq 0$$

$$\mathbf{H} = \begin{bmatrix} \mathbf{X} & \mathbf{WX} & \mathbf{W}^2\mathbf{X} & \cdots \end{bmatrix},$$

(2) estimate **Z** using variable **H**, $\hat{\mathbf{Z}} = \mathbf{H}(\mathbf{H}'\mathbf{H})^{-1}\mathbf{H}'\mathbf{Z}$ as follow

$$\hat{\theta} = (\hat{\mathbf{Z}}'\mathbf{Z})^{-1}\hat{\mathbf{Z}}'\mathbf{y},$$

$$Var(\hat{\theta}) = \hat{\sigma}^2(\hat{\mathbf{Z}}'\mathbf{Z})^{-1}$$

$$\hat{\sigma}^2 = \hat{\boldsymbol{\varepsilon}}'\hat{\boldsymbol{\varepsilon}} / n,$$

$$= (\mathbf{y} - \mathbf{Z}\hat{\theta})'(\mathbf{y} - \mathbf{Z}\hat{\theta}) / n$$

3.3 Performance Investigation of W-Contiguity and W AMOEBA with HDI Data

To evaluate the spatial weighted matrix W_AMOEBA (WG) and W_Contiguity (WC), we used the HDI data of the central of Java (Jateng). Here, we assumed that the HDI between districts have spatial relationships. HDI data is from SUSENAS 2013 BPS JATENG (2014) with single response and four predictors, namely (1) *Y = human development index (HDI), (2)* X_1 *= the average length of school, (3)* X_2 *= overcrowding, (4)* X_3 *= the number of physicians per health center, and (5)* X_4 *= income per capita*

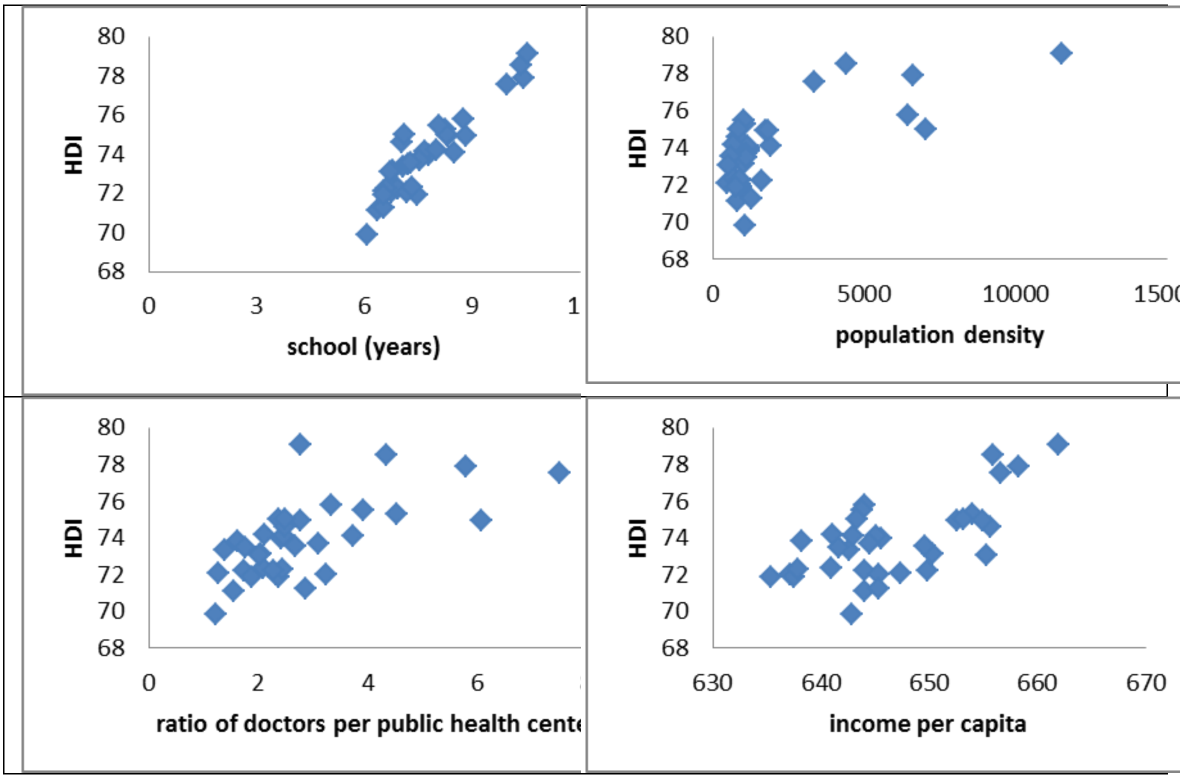

Figure 2. Scatterplot of response variable versus predictors

From Figure 2, we see that relationship between response variable, predictor variables and duration of school factor have significant association to HDI, but not for others factor.

Table 1. ANOVA for SLM model

	WG			WC		
	Est.	Stdev	t.value	Est.	Stdev	t.value
ρ	-0.0060	0.0037	-1.6413	0.1064	0.0977	1.0884
X1	1.9844	0.2501	7.9353	1.8399	0.2417	7.6126
X2	-0.0001	0.0001	-1.8362	-0.0002	0.0001	-1.9517
X3	-0.3844	0.1413	-2.7207	-0.3398	0.1415	-2.4014
X4	0.0932	0.0023	41.2132	0.0821	0.0112	7.3251
R^2		90,0%			89,1%	
RMSE		0.67			0.69	

Table 1 showed that the coefficient R^2 on WG is greater than R^2 on WC. We see also that the root mean square error (RMSE) on WG is less than the RMSE on WC. Finally, we conclude that weighted spatial matrix WG is better than weighted spatial matrix WC.

Prediction of HDI in term of the model with WG and WC are presented Table 2.

Table 2. Predicting values of HDI_WG Y_hat(WG), HDI WC and actual data

No	Y_actual	Y_hat(WG)	Y_hat(WC)	No	Y_actual	Y_hat(WG)	Y_hat(WC)
1	71.13	71.93	71.79	18	78.54	78.9	78.93
2	73.96	74.08	74.11	19	79.1	79.32	78.98
3	72.03	71.72	71.6	20	75.02	74.85	75.09
4	72.1	72.34	72.45	21	74.09	74.78	75.13
5	71.88	72.74	72.8	22	73.67	73.25	73.48
6	69.85	71.32	71.14	23	74.58	74	73.65
7	73.34	72.82	72.88	24	73.14	72.73	72.89
8	73.85	73.36	73.42	25	71.26	71.87	71.67
9	72.37	72	72.38	26	73.49	72.86	72.93
10	74.13	73.63	73.8	27	74.18	74.74	74.38
11	75.27	75.46	75	28	73.53	73.47	73.64
12	72.25	72.53	72.74	29	75.48	74.35	73.96
13	72.03	72.59	72.85	30	72.31	72.94	72.78
14	74.91	75.56	75.58	31	74.91	75.48	75.45
15	77.91	78.33	78.18	32	72.22	72.58	72.35
16	75.75	74.68	75.09	33	75	72.95	72.75
17	77.54	77.14	77.39	34	73.09	73.1	73.1
				35	71.9	71.39	71.42

4. CONCLUSION

For spatial modeling, the response that has a spatial relationship need weighted spatial matrix for accommodating its relationship. The choice of the spatial weighted matrix should consider the characteristics and behavior of the data and adjacent geographical area. AMOEBA weighted matrix is a significant matrix to improve the accuracy of predicting results.

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Parameter Estimation and Hypothesis Testing Geographically Weighted Bivariate Zero-Inflated Poisson

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Abstract—Statistical methods which often used to analyze count data is Poisson regression. However, Poisson regression is not appropriate to be used in analyzing a Zero-inflated count data so that the method used is the Zero-inflated Poisson (ZIP). To model a pair of count data with Poisson distribution and has correlation with some Zero-inflated predictor variable, Bivariate Zero-inflated Poisson Regression (BZIPR) can be used. Therefore, this study was developed in Geographically Weighted Bivariate Zero-inflated Poisson Regression (GWBZIPR). GWBZIP regression parameter estimation was conducted using Maximum Likelihood Estimation (MLE), whereas hypothesis testing was conducted using Maximum Likelihood Ratio Test (MLRT).

Keywords:*Bivariate Poisson Regression, MLE, MLRT, BZIPR, GWBZIPR*

I. INTRODUCTION

Regression analysis is a statistical method that used in various fields, as it provides a simple concept to investigate the functional relationship between the response variable and the predictor variable. If the response consists of positive integers or non-negative valued and stated the number of observations, the response variable is called as a discrete count data [2]. The statistical method used to analyze count data is the Poisson regression [7]. Count data exaggerated with zero value is referred to as Zero-inflated. Zero-inflated can lead to over-dispersion or the mean and variance are not the same [1]. It is therefore not appropriate to use poisson regression in analysing the Zero-inflated count data. Zero-inflated Poisson (ZIP) regression considered as more proper method in dealing with Zero-inflated count data[3]. ZIP regression can be applied to the case of univariate, bivariate and multivariate. Bzipped regression model can produce estimated values of parameters that are global or equal to the entire location. This study developed a Geographically Weighted Bivariate Zero-inflated Poisson Regression (GWBZIPR) model to perform estimation and hypothesis testing using Maximum Likelihood Estimation (MLE) and the determination of the test statistics is using Maximum Likelihood Ratio Test (MLRT).

II. LITERATURE

A. Bivariate Zero-Inflated Poisson Regression

Let Y_1 and Y_2 is a random variable that jointly bivariate Poisson distribution with probability function as follow:

$$f\left(y_1, y_2\right) = \begin{cases} e^{-(\mu_1+\mu_2+\mu_0)} \sum_{k=0}^{\min(y_1,y_2)} \dfrac{\mu_1^{y_1-k}\mu_2^{y_2-k}\mu_0^{k}}{(y_1-k)!(y_2-k)!k!}, & (y_1, y_2) = 0,1,2,... \\ 0 & ,(y_1, y_2)\ others \end{cases} \quad (1)$$

Where the regression equation as follows:

$$(Y_{1i}, Y_{2i}) \sim PB(\mu_{1i}, \mu_{2i}, \mu_0)$$
$$\mu_{ji} + \mu_0 = e^{x_i^T \beta_j} \;\; ; j = 1, 2 \tag{2}$$

Estimation method used in Bivariate Poisson Regression is Maximum Likelihood Estimation (MLE). The method for calculating test statistic onparameter test is Maximum Likelihood Ratio Test (MLRT) :

$$D(\hat{\beta}) = -2\ln\left(\frac{L(\hat{\omega})}{L(\hat{\Omega})}\right) = 2\left(\ln L(\hat{\Omega}) - \ln L(\hat{\omega})\right) \tag{3}$$

where

$L(\hat{\omega})$: Maximum Likelihood for complete model with predictor variable

$L(\hat{\Omega})$: Maximum Likelihood for simple model without predictor variable

B. Generalized Poisson Regression

A pair of count data poisson distribution which has zero value deal on response variables can be analyzed by Bivariate Zero-inflated Poisson Regression. Distribution of Bivariate Zero-inflated Poisson is as follows [6] :

$$f(Y_1, Y_2) = \begin{cases} (1-\pi) + \pi e^{-(\mu_1+\mu_2)}\left(1 + \alpha(1 - e^{-\mu_2 c})\right) & ,(y_1, y_2) = (0,0) \\ \dfrac{\pi e^{-(\mu_1+\mu_2)} \mu_1^{\,y_1} \mu_2^{\,y_2}}{y_1!\, y_2!}\left(1 + \alpha(e^{-y_1} - e^{-\mu_1 c})(e^{-y_2} - e^{-\mu_2 c})\right) & ,(y_1, y_2) \neq (0,0) \end{cases} \tag{4}$$

The regression equation is:

$$\mu_1 = e^{\mathbf{X}^{\mathbf{T}}\boldsymbol{\beta}_1} \text{ dan } \mu_2 = e^{\mathbf{X}^{\mathbf{T}}\boldsymbol{\beta}_2}$$
$$\pi = \frac{e^{\mathbf{X}^{\mathbf{T}}\boldsymbol{\gamma}}}{1 + e^{\mathbf{X}^{\mathbf{T}}\boldsymbol{\gamma}}} \text{ dan } (1-\pi) = \frac{1}{1 + e^{\mathbf{X}^{\mathbf{T}}\boldsymbol{\gamma}}}$$

where $c = 1 - \frac{1}{e}$

C. Corellation Test

Correlation analysis is usually used to measure the linear relationship between the response variable and the predictor variables through a number called the coefficient of correlation. The value of the correlation coefficient ranges between -1 and 1, which shows the relationship of positive and negative. If the correlation value is positive or negative approach of 1 means the two variables have a close relationship. The hypothesis test of correlation between response variable following:

H_0 : there is no relationship between Y_1 and Y_2

H_1 : there is relationship between Y_1 dan Y_2

The test statistic

$$t = \frac{r_{Y_1Y_2}\sqrt{n-2}}{\sqrt{1 - (r_{Y_1Y_2})^2}} \quad \text{where} \quad r_{Y_1Y_2} = \frac{\sum_{i=1}^{n}(y_{1i} - \overline{Y}_1)(y_{2i} - \overline{Y}_2)}{\sqrt{\sum_{i=1}^{n}(y_{1i} - \overline{Y}_1)^2 \sum_{i=1}^{n}(y_{2i} - \overline{Y}_2)^2}}$$

H_0 rejected if $T > t_{\alpha/2}$

D. Multicolinearity Test

Multicollinearity among predictor variables may result inaccurate parameter estimation. Detection of multicollinearity in Poisson regression modeling is very important as correlation between predictor variables with other predictor variables indicate that those two variables have a comparable value. According to [5], the detection of multicollinearity can be done using Variance Inflation Factor (VIF). VIF calculation using the following formula:

$$\text{value } VIF = \frac{1}{1-R_j^{\,2}}$$

E. Spatial Effects

Spatial data on each observation has the characteristics that identify a pair of geographic coordinates or the location of each data covering areas such as agriculture, geology, environmental science and economics [8].Modeling spatial data can be grouped by two types of spatial and spatial point of the area. In modeling the spatial data, spatial weighting matrix is required. Weighting matrix used to represent the scope of information and spatial effects from a location in the system such as geography or the coordinates of latitude and longitude. Spatial heterogeneity between one and other locations indicated by the weighting matrix $W(u_i, v_i)$ whose elements are a function of the Euclidean distance between locations. Form of weighting function of the Euclidean distance use the kernel functions follow,

$$w_{il} = \begin{cases} \left(1-\left(\dfrac{d_{il}}{h_i}\right)^2\right)^2 & \text{, if } d_{il} \le h \\ 0 & \text{, if } d_{il} > h \end{cases}$$

h bandwidth is the radius of a circle where a point located within the radius of the circle considered influential in shaping the parameters of the model location *i*. Determination of the bandwidth will affect the accuracy of the model related to the variance and the bias estimator produced. The optimal bandwidth can be obtained by using the method of Cross Validation (CV) as follows [4]:

$$CV(h) = \sum_{i=1}^{n}\left(y_i - y_{\neq i}(h)\right)^2$$

The identification of spatial heterogeneity is tested using Koenker-Basset.
Hypothesis:

H_0 : no heterogeneity

H_1 : heterogeneity

Statistics test :

$$Z = \frac{\gamma_1}{SE(\gamma_1)}$$

H_0 rejectedif $|Z| > Z_{\alpha/2}$.

F. Geographically Weighted Bivariate Zero-Inflated Poisson Regression (GWBZIPR)

Model GWBZPR is a local form of the Zero-inflated Poisson regression model estimator that will generate local model parameters to each location. GWBZIP distribution is :

$$f(Y_{1j}, Y_{2j}) = \begin{cases} \left((1-\pi_j) + \pi_j e^{-(\mu_{1j}+\mu_{2j})}\left(1+\alpha(1-e^{-\mu_{2j}c})\right)\right) & ,(y_{1j}, y_{2j}) = (0,0) \\ \dfrac{\pi_j e^{-(\mu_{1j}+\mu_{2j})}\mu_{1j}^{\;y_{1j}}\mu_{2j}^{\;y_{2j}}}{y_{1j}!\,y_{2j}!}\left(1+\alpha(e^{-y_{1j}} - e^{-\mu_{1j}c})(e^{-y_{2j}} - e^{-\mu_{2j}c})\right) & ,(y_{1j}, y_{2j}) \neq (0,0) \end{cases} \tag{5}$$

Where

$$\mu_{1j} = e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta}_1(u_i,v_i)} \text{ and } \mu_{2j} = e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta}_2(u_i,v_i)}$$
$$\pi_j = \frac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}} \text{ and } (1-\pi_j) = \frac{1}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}} \tag{6}$$

III. METHOD

Steps to get parameter estimation of GWBZIPR is to determine the likelihood function based on GWBZIP distribution, form and function of the natural logarithm likelihood. And the find the first derivative function of the natural logarithm likelihood under population and define the equation to be equal to zero. If there is no close form solution, Newton-Raphson iteration method is performed to find out the estimator. To test the hypothesis a maximum likelihood ratio test is performed.

IV. RESULT AND DISCUSSION

GWBZIPR model was developed from BZIPR model which use MLE as a method in estimating parameter and resulting a global parameter estimation applied to all locations. Therefore, the estimation of model parameters GWBZIPR will use the MLE method with the likelihood function as follows:

$$L\left(\alpha, \boldsymbol{\gamma}(u_j,v_j), \boldsymbol{\beta_1}(u_j,v_j), \boldsymbol{\beta_2}(u_j,v_j),\ j=1,2,\ldots,n\right) = \underset{(y_{1j},y_{2j})=(0,0)}{\prod_{j=1}^{n} g_j} + \underset{(y_{1j}y_{2j})\neq(0,0)}{\prod_{j=1}^{n} h_j} \tag{7}$$

Where

$$g_j = \frac{1}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(\mathbf{u_i},\mathbf{v_i})}} + \frac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(\mathbf{u_i},\mathbf{v_i})}}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(\mathbf{u_i},\mathbf{v_i})}} \exp\left(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(\mathbf{u_i},\mathbf{v_i})} - e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(\mathbf{u_i},\mathbf{v_i})}\right) \begin{bmatrix} 1+\alpha\left(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(\mathbf{u_i},\mathbf{v_i})}c)\right) \\ \left(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(\mathbf{u_i},\mathbf{v_i})}c)\right) \end{bmatrix}$$

$$h_j = (r)(s)$$

$$r = \frac{\dfrac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(\mathbf{u_i},\mathbf{v_i})}}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(\mathbf{u_i},\mathbf{v_i})}} \exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(\mathbf{u_i},\mathbf{v_i})} - e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(\mathbf{u_i},\mathbf{v_i})})(e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(\mathbf{u_i},\mathbf{v_i})})^{y_{1j}}(e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(\mathbf{u_i},\mathbf{v_i})})^{y_{2j}}}{y_{1j}!\,y_{2j}!}$$

$$s = 1+\alpha(e^{-y_{1j}} - \exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(\mathbf{u_i},\mathbf{v_i})}c))(e^{-y_{2j}} - \exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(\mathbf{u_i},\mathbf{v_i})}c))$$

To estimate the parameters $\left(\alpha, \boldsymbol{\gamma}(u_i,v_i), \boldsymbol{\beta}_1(u_i,v_i), \boldsymbol{\beta}_2(u_i,v_i)\right)$ is

$$\ell = \ln L\left(\alpha, \boldsymbol{\gamma}(u_i,v_i), \boldsymbol{\beta}_1(u_i,v_i), \boldsymbol{\beta}_2(u_i,v_i)\right) = \ln \prod_{j=1}^{n} (g_j)^{1-a_j}(h_j)^{a_j} w_{ij}$$
$$\ell = \sum_{j=1}^{n}(1-a_j)\ln(g_j)w_{ij} + \sum_{j=1}^{n}(a_j)\ln(h_j)w_{ij} \tag{8}$$

Where

$\mu_{1j} = e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}$ and $\mu_{2j} = e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}$

$\pi_j = \dfrac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}}$ and $(1-\pi_j) = \dfrac{1}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}}$

$a_j = 1$ if $(y_{1j}, y_{2j}) \neq (0,0)$ and $a_j = 0$ otherwise. With w_{ij} is the geographical weighting. Ln likelihood of existing functions in equation (8) downgraded to each parameter $\boldsymbol{\beta}_1{}^{\mathbf{T}}(u_i,v_i), \boldsymbol{\beta}_2{}^{\mathbf{T}}(u_i,v_i), \boldsymbol{\gamma}^{\mathbf{T}}(u_i,v_i), \alpha$

$$\frac{\partial\ell}{\partial\boldsymbol{\beta}_1{}^{\mathbf{T}}(u_i,v_i)} = \sum_{j=1}^{n}(1-a_j)(P)(S)(w_{ij}) + \sum_{j=1}^{n}(a_j)Rw_{ij} \tag{9}$$

With

$$P = \left(\frac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}(\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)} - e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}))(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)})\mathbf{x_j}^{\mathbf{T}}}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}(\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)} - e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}))\left(1+\alpha(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))\right)}\right)$$

$$S = \left(1+\alpha(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c)) + \alpha c(-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))\right)$$

$$R = \left(\sum_{j=1}^{n} a_j(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}\mathbf{x_j}^{\mathbf{T}} + y_{1j}\mathbf{x_j}^{\mathbf{T}}) + \sum_{j=1}^{n} a_j \frac{\alpha c\mathbf{x_j}^{\mathbf{T}}(e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)})(-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(e^{-y_{2j}} - \exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))}{1+\alpha(e^{-y_{1j}} - \exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(e^{-y_{2j}} - \exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))}\right)$$

$$\frac{\partial\ell}{\partial\boldsymbol{\beta_2}^{\mathbf{T}}(u_i,v_i)} = \sum_{j=1}^{n}(1-a_j)(\frac{P}{S})w_{ij} + \sum_{j=1}^{n}(a_j)(R)w_{ij} \tag{10}$$

Where

$$P=\left(\begin{array}{l}\left[e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}\left(\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)})\right)(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)})\mathbf{x_j}^{\mathbf{T}}\right]*\\ \left[\begin{array}{l}1+\alpha(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))+\\ \alpha c(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))\end{array}\right]\end{array}\right)$$

$$S=1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}\left(\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)})\right)\left(1+\alpha(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))\right)$$

$$R=\sum_{j=1}^{n}a_j(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}\mathbf{x_j}^{\mathbf{T}}+y_{1j}\mathbf{x_j}^{\mathbf{T}})+\sum_{j=1}^{n}a_j\frac{\alpha c\mathbf{x_j}^{\mathbf{T}}(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)})(e^{-y_{1j}}-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))}{1+\alpha(e^{-y_{1j}}-\exp(-e^{\mathbf{x_{ji}}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(-\exp(e^{-y_{2j}}-e^{\mathbf{x_{ji}}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))}$$

$$\frac{\partial\ell}{\partial\boldsymbol{\gamma}^{\mathbf{T}}(u_i,v_i)}=\sum_{j=1}^{n}(1-a_j)\left(-\frac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}}\mathbf{x_j}^{\mathbf{T}}\right)w_{ij}+\sum_{j=1}^{n}(a_j)\mathbf{x_j}^{\mathbf{T}}\left(1-\frac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}}\mathbf{x_j}^{\mathbf{T}}\right)w_{ij}+$$
$$\sum_{j=1}^{n}(1-a_j)\frac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}\left(\exp(-e^{\mathbf{x_{ji}}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)})\right)*\left(\begin{array}{l}1+\alpha(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))*\\(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))\end{array}\right)}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}\left(\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)})\right)*\left(\begin{array}{l}1+\alpha(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))*\\(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))\end{array}\right)}w_{ij} \quad (11)$$

$$\frac{\partial\ell}{\partial\alpha}=\sum_{j=1}^{n}(1-a_j)\frac{e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}(\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}))(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))}{1+e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\gamma}(u_i,v_i)}\left(1+\alpha(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(1-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))\right)}w_{ij}+$$
$$\sum_{j=1}^{n}a_j\frac{(e^{-y_{1j}}-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(e^{-y_{2j}}-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))}{1+\alpha(e^{-y_{1j}}-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_1}(u_i,v_i)}c))(e^{-y_{2j}}-\exp(-e^{\mathbf{x_j}^{\mathbf{T}}\boldsymbol{\beta_2}(u_i,v_i)}c))}w_{ij} \quad (12)$$

The results of the first derivative of each parameter is explicit or not close the form that will be solved by Newton-Raphson iteration method as follows:

$$\boldsymbol{\theta}_{(m+1)}=\boldsymbol{\theta}_{(m)}-H^{-1}(\boldsymbol{\theta}_{(m)})g(\boldsymbol{\theta}_{(m)}) \quad (13)$$

Where

$$\boldsymbol{\theta}=(\alpha,\boldsymbol{\gamma}(u_i,v_i),\boldsymbol{\beta}_1^{\mathbf{T}}(u_i,v_i),\boldsymbol{\beta}_2^{\mathbf{T}}(u_i,v_i))^{\mathbf{T}} \quad (14)$$

$$g(\boldsymbol{\theta})=\left(\frac{\partial\ell}{\partial\alpha},\frac{\partial\ell}{\partial\boldsymbol{\gamma}(u_i,v_i)},\frac{\partial\ell}{\partial\boldsymbol{\beta}_1^{T}(u_i,v_i)},\frac{\partial\ell}{\partial\boldsymbol{\beta}_2^{T}(u_i,v_i)}\right)^{T} \quad (15)$$

$$\underset{(k+1)(k+1)}{\mathbf{H}(\boldsymbol{\theta}_{(m)})}=\begin{bmatrix}\frac{\partial^2\ell}{\partial\alpha^2} & \frac{\partial^2\ell}{\partial\alpha\partial\boldsymbol{\gamma}^{\mathbf{T}}(u_i,v_i)} & \frac{\partial^2\ell}{\partial\alpha\partial\boldsymbol{\beta_1}^{\mathbf{T}}(u_i,v_i)} & \frac{\partial^2\ell}{\partial\alpha\partial\boldsymbol{\beta_2}^{\mathbf{T}}(u_i,v_i)}\\ & \frac{\partial^2\ell}{\partial\boldsymbol{\gamma}(u_i,v_i)\partial\boldsymbol{\gamma}^{\mathbf{T}}(u_i,v_i)} & \frac{\partial^2\ell}{\partial\boldsymbol{\gamma}(u_i,v_i)\partial\boldsymbol{\beta_1}^{\mathbf{T}}(u_i,v_i)} & \frac{\partial^2\ell}{\partial\boldsymbol{\gamma}(u_i,v_i)\partial\boldsymbol{\beta_2}^{\mathbf{T}}(u_i,v_i)}\\ & & \frac{\partial^2\ell}{\partial\boldsymbol{\beta_1}(u_i,v_i)\partial\boldsymbol{\beta_1}^{\mathbf{T}}(u_i,v_i)} & \frac{\partial^2\ell}{\partial\boldsymbol{\beta_1}(u_i,v_i)\partial\boldsymbol{\beta_2}^{\mathbf{T}}(u_i,v_i)}\\ simetris & & & \frac{\partial^2\ell}{\partial\boldsymbol{\beta_2}(u_i,v_i)\partial\boldsymbol{\beta_2}^{\mathbf{T}}(u_i,v_i)}\end{bmatrix} \quad (16)$$

Hessian matrix is a matrix containing the second derivative of each parameter $\boldsymbol{\beta}_1(u_i,v_i),\boldsymbol{\beta}_2(u_i,v_i),\boldsymbol{\gamma}(u_i,v_i),\alpha$. Steps in parameter estimation using Newton Raphson iteration is as follows:

1. Determining the initial value of parameter.
2. Forming vector $g(\boldsymbol{\theta})(u_i,v_i)$ by substituting equation (9), (10), (11),and (12) into the equation(15)
3. Form the Hessian matrix $\mathbf{H}(\boldsymbol{\theta}_{(m)}(u_i,v_i))$ by substituting the second derivative of equation (9), (10), (11) and (12) to the equation (16).

4. Including the value of $\boldsymbol{\theta}_{(m)}(u_i, v_i)$ into vector elements $g(\boldsymbol{\theta}(u_i, v_i))$ and matrix $\mathbf{H}(\boldsymbol{\theta}_{(m)}(u_i, v_i))$ thus obtained gradient vector $g(\boldsymbol{\theta}_{(m)}(u_i, v_i))$ and Hessian matrix $\mathbf{H}(\boldsymbol{\theta}_{(m)}(u_i, v_i))$.
5. Starting from $m = 0$ to iterate the equation (13). $\boldsymbol{\theta}_{(m)}(u_i, v_i)$ is a set of parameter estimator which converges when iteration to m.
6. If you have not obtained when the parameter estimation convergent iteration to m, then proceed back to step 5 to $m+1$ iteration. Iteration will stop when the value of $\left\|\boldsymbol{\theta}_{(m+1)}(u_i, v_i) - \boldsymbol{\theta}_{(m)}(u_i, v_i)\right\| \le \varepsilon$, ε is number that is very small.

The test statistic in testing parameters for the GWR ZIP model determined by the likelihood function of the model is $L(\Omega)$ which is a maximum likelihood of complete models involving the predictor variables and $L(\omega)$ value is the maximum likelihood for a simple model without involving predictors. To determine the test statistic in testing parameters in this study, Maximum Likelihood Ratio Test (MLRT) is used.

$$\begin{aligned} G &= -2\ln\left(\frac{L(\omega)}{L(\Omega)}\right) \\ &= 2\ln\Big(L(\Omega) - L(\omega)\Big) \end{aligned}$$

RESULT

Estimation of model parameters of Geographically Weighted Bivariate Zero-inflated Poisson Regression using Maximum Likelihood Estimation by Newton-Raphson iteration, produces parameter estimates which do not close the form. The hypothesis is tested using Maximum Likelihood Ratio Test conducted simultaneously and partially by comparing H_0 and the following possibilities population.

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M – 13

Univariate and Multivariate Time Series Models to Forecast Train Passengers in Indonesia

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***Abstract*—** Time series model is one of quantitative methods that frequently used for forecasting a number of train passengers in certain route. In general, there are two types of time series models, i.e. univariate and multivariate time series. The objective of this paper is to apply ARIMA model as a univariate method and VARIMA as a multivariate method for forecasting a number of executive train passengers in Indonesia, particularly Surabaya-Jakarta route. The number of daily train passengers in three types of executive classes that departure from Surabaya Pasar Turi station, i.e. Argo Bromo Anggrek Pagi, Argo Bromo Anggrek Malam, and Sembrani, are used as case study. The data are consisted 761 observations and recorded from January 1st, 2014 till February 27th, 2016 and divided into two parts, i.e. January 1st, 2014 to January 30th, 2016 and 1-27 February 2016 as training and testing data, respectively. Root mean of squares error (RMSE) in testing data is used as criteria to select the best forecasting model. The results show that ARIMA yields more accurate forecast at two data, i.e. number of passengers at Argo Bromo Anggrek Pagi and Sembrani, whereas VARIMA gives better forecast at Argo Bromo Anggrek Malam. Hence, this result inlines with the first conclusion of M3 competition, i.e. statistically sophisticated or complex methods do not necessarily provide more accurate forecasts than simpler ones.

Keywords: *forecasting, train passengers, ARIMA, VAR, RMSE.*

I. INTRODUCTION

The train is known as the mode of transport that has multiple advantages, such as energy saving, land-saving, environmentally friendly, high safety levels, able to transport large amounts, as well as adaptive to technological development [1]. The number of train tickets is sold uncertainty (fluctuatively) everyday. In general, the demand of train tickets at the weekend usually increase compared to normal days. Moreover, the peak of train tickets demand usually occurs one to five days ahead of Idul Fitri due to an annual *mudik* tradition in Indonesia. The term *mudik* refers to the exodus of Indonesian workers from the cities back to their hometowns ahead of Idul Fitri. Not only the Muslim community of Indonesia will return to their places of origin, but also people adhering to other religions traditionally use this public holiday to visit their parents or make a short holiday. This demand peak usually continues after Idul Fitri due to they must going back after this holiday.

A problem often faced by the railway operator is the large supply train ticket quotas are not appropriate to the number of train passengers. The number of train passengers usually increase in the days ahead of the national holidays or certain religious holidays. Due to the railway operator usually only provides the number of tickets as a normal day, this can lead to frustration of the passengers train because many passengers did not get a ticket. Hence, an accurate prediction of the number of rail passengers in the future is important to minimize the number of train passengers who did not get a ticket.

There are some researches on forecasting the train passengers have been conducted such as Andalita [2] who studied about forecasting the number of train passengers in economy class using ARIMA (Autoregressive Integrated Moving Average) and ANFIS (Adaptive Neuro Fuzzy Inference System) methods. Furthermore, Hermawan [3] applied the model NN (Neural Network) for forecasting the number of railway passengers in Jabodetabek. Additionally, Rosyidah [4] employed ARIMA modeling for forecasting of passenger trains on DAOP IX Jember.

In this research, forecasting the number of train passengers in executive class with univariate and multivariate time series. The data will be used is the number of train passengers in three executive trains, i.e. Argo Bromo Anggrek Pagi, Argo Bromo Anggrek Malam and Sembrani. The univariate time series modeling used ARIMA while the multivariate time series modeling employed Vector Autoregressive Integrated Moving Average (VARIMA). Modeling of multivariate time series are not only able to predict the number of passengers in the future, but also could explain the relevance of other types of executives trains. Once the best model of univariate and multivariate time series was obtained, the models were compared based on the accuracy to predict the number of train passengers. In forecasting, multivariate methods are usually more complicated than the univariate method. However as said by Makridakis and Hibon [5] that statistical methods are more sophisticated or more complicated does not always provide more accurate estimates than a simple method. Through the comparison of the two models time series derived from both methods will be obtained the best model to predict the number of rail passengers in the executive class Pasar Turi station.

II. Literature Review

A. Autoregressive Integrated Moving Average (ARIMA)

ARIMA(*p, d, q*) model is a combination of the AR (Autoregressive) order *p* model and MA (Moving Average) order *q* model with differencing order *d*. ARIMA model can be used in the seasonal and non-seasonal data. The ARIMA (*p, d, q*) can be written as follows [6]:

$$\phi_p(B)(1-B)^d Y_t = \mu + \theta_q(B)a_t,$$

Where μ is a constant, $\phi_p(B) = (1-\phi_1 B - \cdots - \phi_p B^p)$ is polynomial backshift operator for AR and $\theta_p(B) = (1-\theta_1 B - \cdots - \theta_q B^q)$ polynomial backshift operator for MA. The procedures used to obtain the forecasting value of using ARIMA consists of four steps starting from the model identification, parameter estimation, diagnostic testing and selection of the best models, forecasting. The identification can be done using ACF (Autocorrelation Function) and PACF (Partial Autocorrelation Function) plots. This step is valid if the time series is stationary that can be visually checked through time series plot. If the data is not stationary in mean, then do differencing whereas if the data is not stationary in variance, then the Box-Cox transformation can be used. The complete steps to do ARIMA modeling can be seen in [4].

B. Vector Autoregressive (VAR)

The VAR model with order one denoted as VAR(1) follows this equation [6]:

$$\boldsymbol{Y_t} = \phi_o + \boldsymbol{\Phi} Y_{t-1} + \boldsymbol{a}_t, \tag{2}$$

The model in (2) that consists of two series can be written in matrix form as follows:

$$\begin{bmatrix} Y_{1,t} \\ Y_{2,t} \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{bmatrix} \begin{bmatrix} Y_{1,t-1} \\ Y_{2,t-1} \end{bmatrix} + \begin{bmatrix} a_{1,t} \\ a_{2,t} \end{bmatrix}, \tag{3}$$

In general, the VAR model of order p denotes as VAR (*p*) is formulates as [4]:

$$\boldsymbol{Y_t} = \phi_o + \boldsymbol{\Phi} Y_{t-1} + \cdots + \boldsymbol{\Phi}_p Y_{t-p} + \boldsymbol{a}_t. \tag{4}$$

The complete description of VAR model can be seen in [6].

C. Model Identification, Diagnostic Checking, and Model Selection

Identification of time series model can be done by creating ACF and PACF plots for the univariate models. The identification step for the multivariate models can be done by employing MPACF (Matrix of Partial Autoregression Function) and the AIC (Akaike Information Criterion) [6].

Checking the assumptions of model is conducted after the identification and parameter estimation steps. The purpose of this step is to determine whether the model fulfills the assumptions. The ARIMA model assumes that the residual is white noise and normally distributed whereas the VARIMA model assumes that the vector of residual is white noise and follows multivariate normal distribution [6].

Selection of the appropriate model was done based on smallest RMSE (Root Mean Squared Error) of out of sample data. The RMSE is calculated as follows [6].

$$\text{RMSE}_{out\ of\ sample} = \sqrt{\frac{1}{L}\sum_{l=1}^{L}\left(Y_{n+l} - \hat{Y}_n(l)\right)^2}.$$

with L is number of observation in out of sample data, Y_{n+l} is observation l in out sample, and $Y_n(l)$ is the value of l-step forecasting.

III. RESEARCH METHODOLOGY

A. Data and Variables

The data used in the study were the data of the number passengers in daily train executive class with Surabaya-Jakarta route in the period from January 1, 2014, until February 29, 2016. These data are secondary data which obtained from Pasar Turi Train Station. There are three types of train executive class data, i.e. the number of passengers in the train Argo Bromo Anggrek Pagi, the number of Sembrani train's passengers, and the number of Argo Bromo Anggrek Malam passengers.

The variables in this study are denoted by $Y_{m,t}$ with m is stating the type of trains and t is stating the time (days). Following is the details of the variables in the study:

$Y_{1,t}$: The daily number of Argo Bromo Anggrek Pagi train passengers

$Y_{2,t}$: The daily number of Argo Bromo Anggrek Malam train passengers

$Y_{3,t}$: The daily number of Sembrani train passengers.

B. Steps of Analysis

1. ARIMA modeling with the following steps:
   a) Stationary inspection of data by looking at the data, ACF and PACF plots. If the data is not stationary variance, we can transform this data. If the data is not stationary in mean, we can difference this data. Formally, Augmented Dickey-Fuller test is used to check the data in the stationary mean.
   b) Identification of the model by ACF and PACF plots to determine the order of AR and MA
   c) Parameter estimation using OLS method.
   d) Selection of the best model by AIC criterion.
   e) Diagnosis check.
   f) Forecasting for data out samples with the selected order.
2. VAR modeling with the following steps:
   a) Inspection stationary of data such as the ARIMA model.
   b) To identify the model by MPACF and minimum AIC value thus obtained VAR order.
   c) Diagnosis check.
   d) Forecasting for data out samples with the model selected.
3. Compare the best model between univariate and multivariate models that have been selected.

IV. ANALYSIS AND RESULTS

A. Descriptive Statistics

The first step in this study was dividing the data into in sample, i.e. January 1, 2014 until January 14, 2015, and out of sample data span from January 15 until February 29, 2016. The descriptive statistics of the data are presented in Table 1. The largest average of the number of train passengers is for train ABAP (Argo Bromo Anggrek Pagi), followed by train ABAM (Argo Bromo Anggrek Malam) and Sembrani. However, the variance for Sembrani is the largest. The correlation between number of train passengers across trains are shown in Table 2.

TABEL 1. DESCRIPTIVE STATISTICS FOR THE NUMBER OF TRAIN PASSENGERS

Train	Average	Variance	Minimum	Maximum
ABAP	350	6304	129	635
ABAM	338	5072	109	540
Sembrani	317	6307	98	544

TABEL 2. CORRELATION OF NUMBER OF PASSENGERS OF BETWEEN TRAINS

Train	ABAP	ABAM	Sembrani
ABAP	1	-	-
ABAM	0.677	1	-
Sembrani	0.666	0.761	1

Table 2 shows that number of passengers between trains are correlated. The strongest correlation is between ABAM and Sembrani. All the correlation are significant with *p*-values are less than 0.05. These facts motivated the use of multivariate time series to model the data.

B. ARIMA Model

ARIMA modeling begins with the identification step given the series stationary. Following is time series plot of the three train's passenger data: ABAP (left), ABAM (middle), and Sembrani (right). Based on time series plot in Figure 1, the data seems to be not stationary. They have high fluctuations. In order to know the stationary of these data, the Box-Cox transformation was used to check it where the results were reported in Table 3.

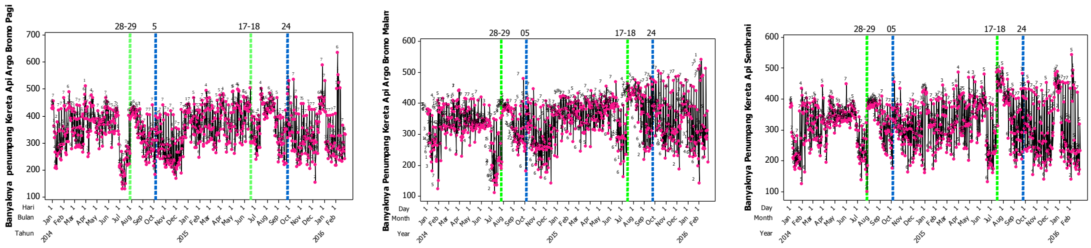

FIGURE 1. TIME SERIES PLOT OF NUMBER OF PASSENGERS TRAINS

TABEL 3. BOX-COX TRANSFORMATION

Variable	Rounded Value	Lower Limit	Upper Limit
ABAP	1	0.82	1.48
ABAM	1.36	1.06	1.71
Sembrani	1.33	1.06	1.65

In the ABAP, the rounded value for the parameter estimate in Box-Cox transformation is one. This indicates that only the ABAP variables are stationary in variance. The series for ABAM and Sembrani are required to be transformed. The next step is to check the stationary in the mean. The checking can be viewed via time series plot and ACF. ACF plot shows a form of a cut off pattern. This shows that the data has not been stationary in the mean. It is necessary to do differencing, i.e. differencing order one and seven. After differencing, the next step is to look at the ACF and PACF plot of the data that has been stationary. Through ACF and PACF plot can be determined the order of ARIMA models. The ACF and PACF plots had been stationary using differencing order one and seven.

The ARIMA models for the ABAP data is ARIMA (0, 1, 1) $(0, 1, 1)^7$ because the ACF plot occurs in the lag 1,6,7,8 are cut off. The modeling for ABAM and Sembrani series need an outlier detection approach because the normality assumption in ARIMA models was not fulfilled. The model for ABAM series is ARIMA ([6,7,8], 1,2)$(0,1,1)^7$ with few outliers whereas the model for Sembrani is ARIMA (7, 1, 1) $(0, 1, 1)^7$ with few outliers. All models have fulfilled the assumptions, i.e. white noise and normality distribution. Thus, the model for $Y_{1,t}$ is:

$$Y_{1,t} = Y_{t-1} + Y_{t-7} - 0.610a_{t-1} - 0.812a_{t-7} + a_{1,t}.$$

The model for $Y_{2,t}$ is:

$$Y_{2,t} = \frac{(1-0.29B-0.21B^2)(1-0.83B^7)}{(1+0.10B^6-0.3B^7+0.27B^8)} a_t + W_{AO} I_t^{(T)}$$

with $W_{AO} I_t^{(T)}$ is:

$$\begin{aligned}
&= -2554.1I_t^{(33)} - 2033.3I_t^{(458)} - 2144.5I_t^{(31)} + 2173.8I_t^{(634)} + 1350.5I_t^{(631)} - 950.3I_t^{(453)} - 1040.3I_t^{(365)} - 1438.7I_t^{(416)} + \\
&\quad - 1548.3I_t^{(39)} + 1116.1I_t^{(452)} - 1389.1I_t^{(486)} + 1084.6I_t^{(14)} + 1224.9I_t^{(107)} + 1103.6I_t^{(271)} + 1116.4I_t^{(361)} - 1031.4I_t^{(208)} + \\
&\quad - 943.9I_t^{(347)} + 741.7I_t^{(689)} - 1447.5I_t^{(609)} - 1319.0I_t^{(610)} + 1154.7I_t^{(358)} + 1046.4I_t^{(134)} - 687.0I_t^{(730)} + 1005.9I_t^{(291)} + \\
&\quad - 979.1I_t^{(121)} + 1025.2I_t^{(10)} + 1028.4I_t^{(705)} + 1016.3I_t^{(551)} + 1169.0I_t^{(206)} + 1006.7I_t^{(444)} + 1272.1I_t^{(187)} + 1168.1I_t^{(194)} + \\
&\quad 986.8I_t^{(190)} + 781.8I_t^{(176)} + 792.9I_t^{(594)} + 974.8I_t^{(718)} + 838.5I_t^{(161)} - 822.2I_t^{(632)} - 764.6I_t^{(707)} - 1029.9I_t^{(38)} + 881.5I_t^{(652)} + \\
&\quad 1234.4I_t^{(655)} + 1093.3I_t^{(648)} + 830.7I_t^{(280)} - 735.4I_t^{(431)} + 492.5I_t^{(725)} + 1006.2I_t^{(326)} + 634.1I_t^{(269)} - 707.4I_t^{(337)} + 612.4I_t^{(297)} + \\
&\quad 961.5I_t^{(199)} - 824.9I_t^{(471)} + 904.5I_t^{(681)} + 717.4I_t^{(16)} + 1384.1I_t^{(30)} - 595.1I_t^{(92)} + 696.7I_t^{(152)} + 724.2I_t^{(211)} - 842.2I_t^{(311)} + \\
&\quad 522.7I_t^{(455)} - 502.7I_t^{(533)} - 662.8I_t^{(483)} - 699.6I_t^{(378)} + 649.4I_t^{(185)} + 659.9I_t^{(414)}.
\end{aligned}$$

The model for $Y_{3,t}$ is :

$$Y_{3,t} = \frac{(1-0.44B)(1-0.88B)^7}{(1+0.09B^2-0.28B^7+0.12B^8)} a_t + W_{AO} I_t^{(T)} + W_{ls} I_t^{(T)},$$

with $W_{AO} I_t^{(T)}$ and $W_{ls} I_t^{(T)}$ is:

$$\begin{aligned}
&= 2334.9I_t^{(631)} - 1249.5I_t^{(31)} + 1786.0I_t^{(452)} - 1467.7I_t^{(486)} + 1243.9I_t^{(457)} + 1299.5I_t^{(358)} + 1441.3I_t^{(414)} - 1538.4I_t^{(39)} + \\
&\quad - 1131.3I_t^{(530)} + 1268.8I_t^{(485)} + 1296.6I_t^{(444)} - 1689.9I_t^{(366)} - 1392.7I_t^{(208)} + 1211.1I_t^{(306)} + 1396.1I_t^{(636)} + -1237.3I_t^{(458)} \\
&\quad + 1123I_t^{(498)} + 1073.9I_t^{(696)} + 1098.0I_t^{(87)} - 1075.6I_t^{(283)} + 1003.5I_t^{(368)} + 1024I_t^{(623)} - 1000.2I_t^{(416)} - 888.9I_t^{(564)} - 973.2I_t^{(53)} + \\
&\quad 981.5I_t^{(735)} + 896.8I_t^{(402)} - 1122.5I_t^{(736)} - 1630.6I_t^{(365)} + 1523.4I_t^{(30)} + 1372.3I_t^{(634)} - 1060.0I_t^{(737)} + 1559.4I_t^{(361)} + \\
&-654.8I_t^{(5)}.
\end{aligned}$$

C. VARIMA Model

VARIMA modeling begins with the identification step based on MACF and MPACF plots and AIC. The series for three train passenger were differenced order one and seven because the data are not stationary in the mean. These series were transformed using Box-Cox transformation because they are not stationary in variance. The minimum value of the AIC indicated that the proper model is VARIMA $(30,1,0)(0,1,0)^7$.

The results of parameter estimation of VARIMA $(30,1,0)(0,1,0)^7$ indicates that the model has 270 parameters. However, the *p*-value of each parameter some parameters were not significant. So, the model need restrict some parameters. This restriction process start from the parameter estimate with the highest *p*-value until all parameter estimates had *p*-value less than Type-I error (α = 0.05). The results of parameter estimation VARIMA $(30,1,0)(0,1,0)^7$ with restriction showed that there are 78 parameters that were significant in the model. The VARIMA $(30,1,0)(0,1,0)^7$ model for the series of the number of train passengers is:

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$$
\left(\begin{bmatrix}1&0&0\\0&1&0\\0&0&1\end{bmatrix}-\begin{bmatrix}-0.7&0,01&0.1\\0&0.7&0\\0&0&-0.7\end{bmatrix}B-\begin{bmatrix}-0.4&0&0.1\\0.3&-0.6&0\\0&0&0.6\end{bmatrix}B^{2}+\begin{bmatrix}-0.3&0&0.1\\0.7&-0.4&0.4\\0&0&0.3\end{bmatrix}B^{3}-\begin{bmatrix}-0.2&0&0\\0.7&-0.3&0\\0.1&0&-0.3\end{bmatrix}B^{4}-\begin{bmatrix}-0.1&0&0.1\\0&-0.2&0.5\\0.1&0&-0.2\end{bmatrix}B^{5}+\right.
$$

$$
-\begin{bmatrix}-0.1&0&0\\0&-0.2&0\\0&0&0.1\end{bmatrix}B^{6}-\begin{bmatrix}0.7&0&0\\0&-0.7&0\\0&0&-0.7\end{bmatrix}B^{7}-\begin{bmatrix}-0.44&0&0.1\\0&-0.5&0\\0&0&-0.5\end{bmatrix}B^{8}-\begin{bmatrix}-0.24&0&0\\0&-0.4&0\\0&0&0.4\end{bmatrix}B^{9}-\begin{bmatrix}0.2&0&0\\0&-0.2&0\\0&0&-0.2\end{bmatrix}B^{10}-\begin{bmatrix}0.1&0&0\\0&-0.2&0\\0&0&-0.1\end{bmatrix}B^{11}+
$$

$$
-\begin{bmatrix}0&0&0\\0&-0.1&0\\0&0.1&0\end{bmatrix}B^{12}-\begin{bmatrix}0.4&0&0\\0&-0.4&0\\0&0&-0.5\end{bmatrix}B^{14}-\begin{bmatrix}-0.3&0&0\\0&-0.3&0\\0&0&-0.4\end{bmatrix}B^{15}-\begin{bmatrix}-0.1&0&0\\0&-0.2&0\\0&0&-0.3\end{bmatrix}B^{16}-\begin{bmatrix}-0.1&0&0\\0&-0.1&0\\0&0&-0.2\end{bmatrix}B^{17}-\begin{bmatrix}-0.1&0&0\\0&0&0\\0&0&0\end{bmatrix}B^{18}+
$$

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-\begin{bmatrix}0&0&0\\0&0&0\\0.1&0&0\end{bmatrix}B^{19}-\begin{bmatrix}0.1&0&0\\0&0&0\\0.1&0&0\end{bmatrix}B^{20}-\begin{bmatrix}-0.3&0&0\\0&0.3&0\\0&0&-0.3\end{bmatrix}B^{21}-\begin{bmatrix}-0.2&0&0\\0&-0.2&0\\0&0&-0.2\end{bmatrix}B^{22}-\begin{bmatrix}0&0&0.1\\0&0.1&0\\0&0&-0.2\end{bmatrix}B^{23}+\begin{bmatrix}-0.1&0&0\\0&0.1&0\\0&0&-0.1\end{bmatrix}B^{24}+\begin{bmatrix}-0.1&0&0\\0&0&0\\0&0&0\end{bmatrix}B^{25}+
$$

$$
\left.\begin{bmatrix}-0.2&0&0\\0&-0.2&0\\0&0&-0.2\end{bmatrix}B^{28}+-\begin{bmatrix}-0.1&0&0\\0&-0.1&0\\0&0&0\end{bmatrix}B^{29}\right)\times\begin{bmatrix}(1-B)(1-B^{7})Y_{1,t}\\(1-B)(1-B^{7})Y_{2,t}\\(1-B)(1-B^{7})Y_{3,t}\end{bmatrix}+\begin{bmatrix}a_{1,t}\\a_{2,t}\\a_{3,t}\end{bmatrix}.
$$

Based on the model that had been established, the next step is testing the assumptions on residual. In multivariate time series modeling, to testing the assumption of white noise on the residual can be done by looking at the results of the portmanteau test. In this study, testing the white noise used AIC criterion calculated from the residual of VARIMA $(30,1,0)(0,1,0)^7$ model. Based on Table 4, the smallest AIC value is in AR (0) and MA (0). This suggests that the residuals of the model have fulfilled the white noise assumption.

TABEL 4. MINIMUM INFORMATION CRITERION OF RESIDUAL

Lag	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR(0)	27.26852	27.32797	27.32771	27.32819	27.32541	27.3277
AR(1)	27.28481	27.31673	27.32693	27.3307	27.33645	27.34313
AR(2)	27.29714	27.32953	27.33551	27.33822	27.34943	27.35946
AR(3)	27.3034	27.3347	27.33804	27.34664	27.35837	27.37177
AR(4)	27.30585	27.3421	27.35016	27.35857	27.37946	27.39254
AR(5)	27.31611	27.35402	27.36436	27.37477	27.39558	27.4099

The next assumption that must be fulfilled is multivariate normal distribution for the vector of residual. The null hypothesis of the test is that the residuals follows have multivariate normal distribution. The null hypothesis will be fail to be rejected if the *p*-value of the statistic test exceed the value of Type-I error. The evaluation of the multivariate normal assumption test can also be done visually through QQ plot of the residual. The assumption is fulfilled when residual plot tends to form a straight diagonal line as displayed by Figure 2. Moreover, if the proportion of values which generated through calculation are at least 50% greater than the value of statistic test, in this study is about 83%, the null hypothesis is fail to be rejected. Therefore, residuals of the VARIMA $(30,1,0)(0,1,0)^7$ model have multivariate normal distribution.

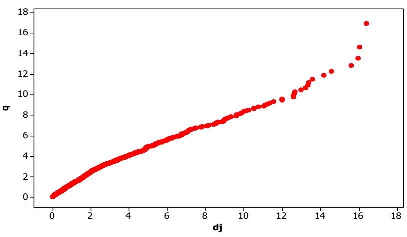

FIGURE 2. QQ PLOT FOR RESIDUALS

Once the best model for ARIMA and VARIMA were obtained, the out of sample forecast can be calculated for the series. The RMSE out of the samples were reported in Table 5. The models for ABAP and Sembrani have relatively large RMSE for both univariate and multivariate models. This indicates that the two models are less good than the model for ABAM. The comparison of RMSE out samples for univariate and multivariate models indicated that multivariate model, which is more complex, were not always resulted in better prediction than the simpler model. Often in some studies suggest that more complicated method will yield better accuracy but the reality is not always so. Table 6 reported the forecasting value obtained from ARIMA model for each train.

TABEL 5. THE COMPARISON RMSE OUT OF SAMPLE FOR UNIVARIATE AND MULTIVARIATE

Variable	RMSE Out of Sample for ARIMA	RMSE Out of Sample for VARIMA
ABAP	111.5	133.8
ABAM	91.2	77.5
Sembrani	102.1	120.0

TABEL 6. THE RESULTS OF FORECASTING FOR EACH TRAIN

Dates	ARIMA			Dates	ARIMA		
	ABAP	ABAM	Sembrani		ABAP	ABAM	Sembrani
15-Jan-16	274	372	287	6-Feb-16	253	285	150
16-Jan-16	295	285	213	7-Feb-16	339	432	308
17-Jan-16	382	432	369	8-Feb-16	255	305	167
18-Jan-16	297	305	226	9-Feb-16	197	286	153
19-Jan-16	240	286	198	10-Feb-16	190	322	165
20-Jan-16	232	322	219	11-Feb-16	213	281	162
21-Jan-16	255	281	204	12-Feb-16	218	369	234
22-Jan-16	260	369	269	13-Feb-16	239	281	137
23-Jan-16	281	281	182	14-Feb-16	325	430	297
24-Jan-16	368	430	337	15-Feb-16	241	302	155
25-Jan-16	283	302	198	16-Feb-16	183	283	140
26-Jan-16	225	283	180	17-Feb-16	176	318	152
27-Jan-16	218	318	194	18-Feb-16	199	280	150
28-Jan-16	241	280	188	19-Feb-16	204	366	223
29-Jan-16	246	366	256	20-Feb-16	225	278	124
30-Jan-16	267	278	165	21-Feb-16	311	428	287
31-Jan-16	354	428	320	22-Feb-16	227	299	142
1-Feb-16	269	299	181	23-Feb-16	169	281	127
2-Feb-16	211	281	166	24-Feb-16	162	315	139
3-Feb-16	204	315	178	25-Feb-16	185	278	137
4-Feb-16	227	278	175	26-Feb-16	190	363	212
5-Feb-16	232	372	245	27-Feb-16	211	276	110

V. CONCLUSIONS AND RECOMMENDATIONS

The empirical results found that the best model for univariate approach to model number of passenger train are ARIMA $(0,1,1)(0,1,1)^7$ for Argo Bromo Anggrek Pagi, ARIMA$([6,7,8],1,2)(0,1,1)^7$ with outliers detection for Argo Bromo Anggrek Malam, and ARIMA $(7,1,1)(0,1,1)^7$ with outliers detection for Sembrani. The multivariate models appropriate to model these three series is VARIMA $(30,1,0)$ $(0,1,0)^7$. Based on the RMSE value for out of sample data, it can be concluded that the ARIMA model had better prediction for two series whereas the VARIMA model outperformed in one series, i.e. series for Argo Bromo Anggrek Malam.

The empirical results also showed that many outliers were found in the data and influenced the forecast accuracy of both univariate and multivariate models. Hence, more detail about outlier detection can be done for further research. Moreover, non linear time series models such as ANN (Artificial Neural Network) which is flexible to overcome data with outliers also could be considered as a future research for forecasting train passengers in Indonesia.

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M – 14

Derivation of One Dimensional Continuity Equation for Fluid Flows in Deformable Pipelines

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***Abstract*—**This paper discusses the derivation of one dimensional continuity equation for fluid flows in deformable pipelines. In this case, the meaning of deformable pipelines is the pipe cross-sectional area change due to fluid flow. In this paper, it is assumed homogeneous fluid, the flow is laminar, and always fill each section of pipelines. In the process of the derivation of continuity equation for fluid flows, we used the Mass Conservation Law. The mass change of fluid flow at each time equals to zero, or in other words, the incoming mass equals to the mass coming out. To find a mass of fluid flow, we used the concept of a fluid density and integral concept of Leibniz. Integral limit on the mass of fluid flow changes at any time and mass fluid flow will be differentiated with respect to time, so we need to use the integral concept of Leibniz. Based on the Mass Conservation Law, we concludeD that the fluid flow mass derivative with respect to time is equal to zero. Thus, we got the equation of mass fluid flow derivative with respect to time is equal to zero, which then called as continuous fluid flow equations.

Keywords:*fluid flows, continuity equation, deformable pipelines.*

I. INTRODUCTION

Many everyday events in our environment are examples of the flow of liquid or gas for example the flow of water from the faucet, water flowing from a hole bath, the flow of gas in the regulator, and others. The natural disasters that have occurred in Indonesia are also the examples of a flow such as, floods, tsunamis, volcanic eruptions due to the lava flow, and the spread of smoke from forest fires. That events and natural disasters have the same basic, the liquid or gas flow. In physics, the amount that can flow included liquids and gases is called the fluid. Therefore, the authors are interested in analyzing mathematical modeling of the fluid flow. Fluid flow basically have boundary. In this paper, the fluid is confined in a space which later we called is as a pipeline.

There are several researches about mathematical modeling of the fluid flow that have been done which one of them is by Zusnita Meyrawati. Zusnita have analyzed the mathematical modeling of gas in pipeline[1]. While, Dr. Ir. Ahmad Indra S, Ridwan ST.MT, and Irwan Setiawan have analyzed fluid flow in spiral pipe [2]. But, both of them analyzed fluid flow in the undeformable pipeline. In this paper, the mathematical modeling of the fluid flow will be analyzed in the deformable pipeline.

In our environment, fluid flows continuously. Moreover, mathematical model which is representing it is the fluid continuity equation. In the research before, the continuity equation of fluid in the pipe were analyzed with pipes that can not be deformed. Therefore, in this paper will be discussed about the derivation of one dimensional continuity equation for fluid flows in deformable pipelines and the fluid will be analyzed as the arrangement of the particles that establish the fluid. In this case, the deformable pipeline is the pipe cross-sectional area size changes.

II. METHODS

In the derivation of fluid continuity equation, we used the following steps to make it easier to get fluid continuity equation.

1. Study the literature of the fluid and the continuity equation.
   A literature study by studying some books, journals, and papers of fluid flow and continuity equation.

2. Analyze the fluid flow and fluid characteristics.
   After studying fluid flow, then we analyzed the fluid flow and the characteristics of the fluid flow. In this paper, to obtain a fluid continuity equation, we need to analyze the mass of fluid flow.
3. Assumptions to ease the derivation of fluid continuity equation.
   The assumption is required to ease the authors in the derivation of the fluid continuity equation.
4. Formulate the mass of fluid flow.
   Mass of fluid flow is analyzed by assuming the fluid flow is a composition of small particles. These particles are partitions of fluid flow in the pipe.
5. Formulate the fluid continuity equation.
   Fluid continuity equation obtained after we get the mass of fluid flow. This is because the fluid continuity equation is the development of mass conservation law. In addition, the derivation process of fluid continuity equations, used some of the rules of derivatives and integrals.

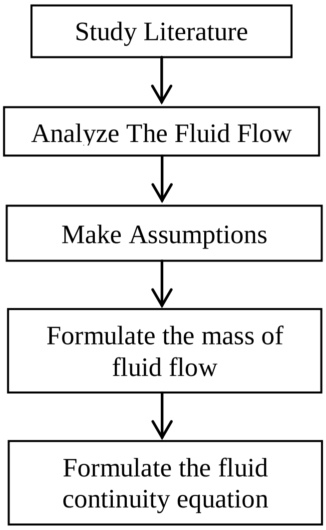

FIGURE 1. THE STEPS OF DERIVATION OF FLUID FLOW EQUATION

III. DERIVATION OF FLUID CONTINUITY EQUATION

Fluid is a substance that can deform continuously, when it was exposed by shear stress, however small it is [3]. Fluid is something that can flow, so it is often referred to as a flow agent, can be either a liquid or gas. Liquid and gas phases have the characters do not maintain a fixed shape, so that both have the ability to flow, thus both called fluids. Actually, fluid flow is not a simple phenomenon and it occurs in three dimensional and also dependent with time. However, in many situations, it can be assumed with the simplification of fluid flow to make much easier understanding on the issue of the flow without compromising the level of accuracy required. One of this simplification is the real flow approach (in fact) as a stream of simple one or two-dimensional [4].

In the derivation of the fluid continuity equation, we used the dynamic fluid as it moves continuously. The fluid is assumed that always fill all parts of the pipe continuously. The assumptions in the flow process using the conditions as below.

1. Real Fluid.
   The fluid is a real fluid (not the ideal fluid). Real fluid has a viscosity, while ideal fluid has no viscous or without friction.
2. The fluid is a homogeneous fluid.
   Homogeneous fluid is a fluid that is not derived from a mixture of several substances, so that the fluid does not have a concentration but has a density.
3. Fluid always filled the entire section of pipe continuously.
   The flow of fluid has never stopped.The fluid always flowing and filled the pipelines.
4. Fluid flow is laminar flow or straight flow.
   Laminar flow is the flow of entire fluid particles move along a straight line parallel and follow the flow direction (or parallel to the center line of the pipe, if the fluid flowing in the pipe).

5. The fluid flows only to the direction of positive abscissa.
   The fluid flows toward the positive abscissa and does not flow toward the negative abscissa and does not flow toward the ordinate.

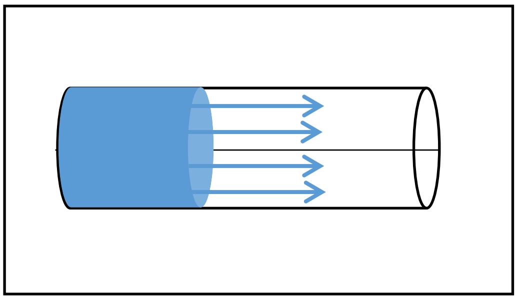

FIGURE 2. ILLUSTRATION OF LAMINAR FLOW AND POSITIVE ABSCISSA DIRECTION

6. The viscosity (thickness) of fluid is constant.
   Fluid viscosity is constant with respect to the fluid is a homogeneous fluid.
7. Friction which in line with ordinate is ignored.
   Fluid flows toward the positive abscissa, so that the frictional forces that considered only the frictional forces in the direction of the abscissa.

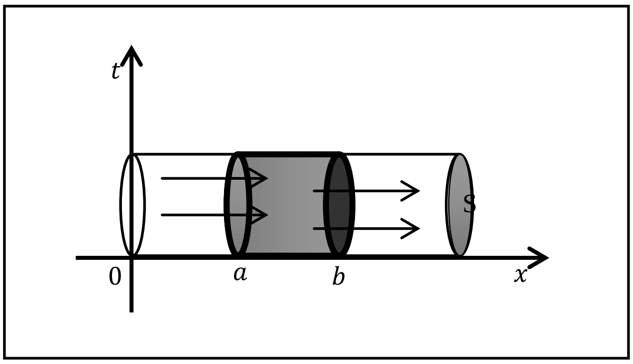

FIGURE 3. FLUID FLOW IN PIPELINE

The continuity equation is the development of Mass Conservation Law. The Mass Conservation Law is the mass of the incoming fluid flow is equal to the mass of fluid flow out [5]. Therefore, the mass of fluid flow in the pipe is required to obtain a fluid continuity equation. To analyze the mass of fluid flow mathematically, the fluid analyzed from tiny particles contained in the fluid. Mass of fluid flow is obtained by adding the masses every partition or small particles in the fluid. Figure 2.2 above is an illustration of the fluid flowing in the pipe. Interval [a, b] is selected to analyze the mass of fluid flow in the pipe. At the interval [a, b] is partitioned into n partitions, in order to obtain part of the partition that $[x_i, x_{i+1}]$ with $i = 1,2,3, \ldots, n$and $x_{i+1} - x_i = \Delta x$. For more details, can be seen in Figure 3 below.

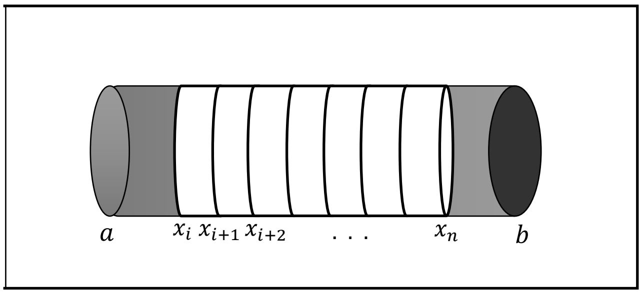

FIGURE 4. PARTITIONS OF FLUID FLOW IN INTERVAL [A,B]

Mass of fluid flow(M) is the sum of the mass (m) of region i to region $i+1$. A mass equal to the product of the fluid density (ρ) and volume (V) [6]. To analyze the volume of fluid partition, used the assumption that the volume of partition equals to the volume of the tube. Volume of tube is the multiplication between the base area andheightof the tube. In this case, the base area is equal to the pipe cross-sectional area (S) and a height equal to Δx. Fluid density (ρ), volume (V) and the pipe cross-sectional area (S) is not constant at any point within the fluid. Suppose that there are $x_i^* \in [x_i, x_{i+1}]$, the masses in the region $[x_i, x_{i+1}]$ can be written as follows.

$$m_i = \rho(x_i^*, t) \cdot S(x_i^*, t).\Delta x \tag{1}$$

Equation (1) is the mass of region i to region $i+1$. From (1) obtained the approach of a fluid flow mass value (M) as follows.

$$M \approx \sum_{i-1}^{n} m_i \tag{2}$$

Equation (1) substituted into (2), so that

$$M \approx \sum_{i=1}^{n} \rho(x_i^*, t) \cdot S(x_i^*, t).\Delta x \tag{3}$$

The value of M in (3) is an approximation of fluid flow mass value (M). To get the actual value of M, we used the limit value with n is infinity (given the presence of n infinity partitions on the interval [a,b]). Therefore, we got the value of M as follows.

$$M = \lim_{n\to\infty} \sum_{i-1}^{n} \rho(x_i^*, t) \cdot S(x_i^*, t) \cdot \Delta x \tag{4}$$

According to the definition of the Riemann Integral [7] which states that let M is a function defined on a closed interval [a,b], such that the value of M there, and M integral on the interval [a,b], so that (4) into

$$M = \int_a^b \rho(x,t) \cdot S(x,t) dx \tag{5}$$

with a and b is a function on t.

The continuity equation is the development of Mass Conservation Law which is the mass of the incoming fluid flow is equal to the mass of fluid flow out, so the changes of mass of the fluid flow at each time is equal to zero.

$$\frac{dM}{dt} = 0 \tag{6}$$

Equation (5) substituted into (6), so we obtain

$$\frac{d}{dt} \int_a^b \rho(x,t) \cdot S(x,t) dx = 0 \tag{7}$$

Boundary integral a and b is a function on t, based on Leibniz integral rule, so (7) can be writen into the following

$$\frac{d}{dt} \int_a^b \rho(x,t) \cdot S(x,t) dx = \int_a^b \frac{\partial}{\partial t} [\rho(x,t) \cdot S(x,t)] dx + \rho(x,t) \cdot S(x,t)\Big|_b \frac{db}{dt} - \rho(x,t) \cdot S(x,t)\Big|_a \frac{da}{dt}$$

For the case of liquid media volume, the value of db/dt and da/dt is equal to the speed at the time of b and a. Therefore,

$$\frac{d}{dt}\int_a^b \rho(x,t)\cdot S(x,t)dx = \int_a^b \frac{\partial}{\partial t}[\rho(x,t)\cdot S(x,t)]dx + \rho(x,t)\cdot v(x,t)\cdot S(x,t)\Big|_b - \rho(x,t)\cdot v(x,t)\cdot S(x,t)\Big|_a \quad (8)$$

Based on the Calculus Base Theorem I [7],

$$\rho(x,t)\cdot v(x,t)\cdot S(x,t)\Big|_b - \rho(x,t)\cdot v(x,t)\cdot S(x,t)\Big|_a = \int_a^b \frac{\partial}{\partial x}[\rho(x,t)\cdot v(x,t)\cdot S(x,t)]dx$$

Equation (8) becomes

$$\frac{d}{dt}\int_a^b \rho(x,t)\cdot S(x,t)dx = \int_a^b \frac{\partial}{\partial t}[\rho(x,t)\cdot S(x,t)]dx + \int_a^b \frac{\partial}{\partial x}[\rho(x,t)\cdot v(x,t)\cdot S(x,t)]dx \quad (9)$$

Equation (9) is simplified by using the definition of the total derivative, so we obtain

$$\frac{d}{dt}\int_a^b \rho(x,t)\cdot S(x,t)dx = \int_a^b \left(\frac{\partial \rho S}{\partial t} + \frac{\partial \rho v S}{\partial x}\right)dx \quad (10)$$

Based on the equation (7) and (10) can be obtained that

$$\int_a^b \left(\frac{\partial \rho S}{\partial t} + \frac{\partial \rho v S}{\partial x}\right)dx = 0 \quad (11)$$

According to Integral Theorem, if the integral of a function is equal to zero, the function is a function to zero, so that (11) becomes

$$\frac{\partial \rho S}{\partial t} + \frac{\partial \rho v S}{\partial x} = 0 \quad (12)$$

Equation (12) is called the Continuity Equation of Fluid in Pipe.

III.CONCLUSION

This paper was created to analyze to derivatethe one dimensional continuity equation for fluid flows in deformable pipelines.. In this case, deformable pipelines is the pipe cross-sectional area size changes. The fluid is a real fluid and homogeneous fluid. We used laminar flow or straight flow. The fluid flows only to the direction of positive abscissa. Fluid flows continuously in the pipeline, and the fluid is always filled each part of the pipeline.

Fluid continuity equation is the development of the Mass Conservation Law. Therefore, it is necessary to analyze the mass of fluid flow in the pipelines. To analyze the mass of fluid flow mathematically, the fluid analyzed from small particles in the fluid, so that the fluid in the pipe is partitioned into infinite parts. Approach mass fluid flow is obtained by totaling the masses every partition or small particles in the fluid. To obtain a mass of fluid flow, usable limit of the sum of masses each partition.

In the process of the derivative of fluid continuity equation, integral limit on the mass of fluid flow changes at any time and mass fluid flow will be differentiated with respect to time, so we need to use the integral concept of Leibniz. Based on the Mass Conservation Law, we concluded that the fluid flow mass derivative with respect to time is equal to zero. Thus, we got the equation of fluid flow mass derivative with respect to time is equal to zero, which is called the continuity equation of fluid flow.

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M – 15

Nonlinearity Test on Time Series Data

Case Study: The Number of Foreign Tourists

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Abstract— *Time series data analysis is a method for modeling a data pattern. Forecasting is one of the main points in a time series analysis. difficult to choose the method of parametric models that are not linear. Before forecasting time series data nonlinearity testing should be done in order to explain the nonlinear relationships in the variable and testing procedures to detect the presence of nonlinear relationships. Some alternative methods that can be used to test the nonlinearity is Ramsey's RESET test, White test and Terasvirta test. Ramsey's RESET test is a test used to detect nonlinearity using general tests for specification error (Gujarati, 1996). White Test is a test developed to detect nonlinearity of neural network models were invented by White (1989). Terasvirta test is a test used to detect nonlinearity were also developed from neural network models and are included in the test group developed type of Lagrange Multiplier with Taylor expansion (Terasvirta, 1993). The purpose of this study was to demonstrate that the data on the number of foreign tourists is the data nonlinear with nonlinearity is tested using three methods: Ramsey's RESET test, White test and Terasvirta test. In this study will use data on the number of foreign tourists at Juanda airport in 2000 until 2015.*

Keywords: *nonlinearity test, time series data, number of foreign tourists*

I. INTRODUCTION

Time series data is a series of observations on a value taken at different times. Time series data is data in chronological order. Time Series is a series of variables that form the observation values observed from time to time and recorded in accordance with the sequence of events and the data is assumed to be interdependent with one another (dependent). Such data can be collected periodically at certain time intervals, such as daily, weekly, monthly, or yearly. Autoregressive which is one of the Time Series models, first introduced by [8] and later developed by [5]. Autoregressive models of order p or AR (p) states that the value of observation all t depend on the values of p observations throughout the previous period.

But in some cases, the relationship between the data have shaped nonlinear tendencies. Based on these cases, necessary to test to show time series data used in the model included linear or nonlinear models. The test can be used to indicate that data be linear or nonlinear. There are some test that can be used to show the nonlinearity. Non linearity test used in this study were White test, Ramsey's RESET test and Terasvirta test. Ramsey's RESET test is a test used to detect nonlinearity using general tests for specification error [1]. White Test is a test developed to detect nonlinearity of neural network models were invented by [7]. Terasvirta test is a test used to detect nonlinearity were also developed from neural network models and are included in the test group developed type of Lagrange Multiplier with Taylor expansion [3].

several studies using non-linear models such, testing for nonlinearity in time series: the method of surrogate data [4] indicating that correctly identifies nonlinearity in several well-known examples of low-dimensional chaotic time series, event when contaminated with dynamical and observational noise.

linearity test data time series with reset test [6] showed the results of the data generated from nonlinear models produce nonlinearitas significant at 5%.

based on previous studies, the test nonlinearitas actually quite important in identifying the time series data that is used for helping to sort the data in the model is a linear or nonlinear models. if included in the linear model can be regressed using a parametric regression otherwise if included in the nonlinear model can be regressed using nonparametric regression or semiparametric regression. Therefore in this study, the test will be conducted non-linearity in the time series data. time series data used is data on the number of foreign tourists at the airport juanda in 2000 to 2015.

II. AUTOREGRESSIVE MODEL

Autoregressive model is a model that describes the dependent variable influenced by the dependent variable itself in periods previously, or autocorrelation can be interpreted also as a linear correlation sequence periodically with time series itself with a time difference (lag) 0, 1, 2 or more periods. The general form autoregressive model with order p or written with AR (p) has the following equation:

$$Y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + e_t \quad (1)$$

Where:
Y_t = the value of a variable at t
ϕ_i = autocorrelation parameter i-th with i= 1,2,...,p
e_t = error value in t

A. *Autoregressive 1*

AR order are often used in time series analysis is p = 1 is a model AR (1). AR (1) stated that the observed values to t depends on the values of the observations throughout the previous period. The general form autoregressive model with order 1 or written with AR (1) has the following equation:

$$Y_t = \phi_1 Y_{t-1} + e_t \quad (2)$$

Where:
Y_t = the value of a variable at t
ϕ_1 = autocorrelation parameter
e_t = error value in t

III. NONLINEARITY TEST

According to [2] some tests to detect non-linear relationships between variables in time series analysis. in this section the discussion focused on the detection nonlinearitas on a time series model, particularly Ramsey's RESET test, test and test Terasvirta White. The following is an explanation for each of the nonlinearitas test.

A. *Ramsey's RESET test*

Ramsey has proposed a general test of specification error called RESET (regression specification error test). The general shape models describing the relationship among the independent variables (predictors) and the dependent variable (response) can be written:

$$Y = f\left(X\right) + \varepsilon \quad (3)$$

Hypothesis testing used in the test are the nonlinearitas:
$H_0 : f\left(X\right)$ is a linear function of the X or the linear model
$H_1 : f\left(X\right)$ is a nonlinear function of the X or the nonlinear model

H_0 is rejected, which means non-linear model is appropriate, if the value of the F test meets namely the rejection region

$$F > F_{\alpha;(df_1,df_2)} \text{ atau } p\text{-}value < \alpha \quad (4)$$

The following steps in the RESET test by [1]:

1. Regression of Y_t on $1, x_1, x_2, ..., x_p$ and calculate the estimated values of the response variable $\hat{Y}_t$, so:
$$\hat{Y}_t = \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p \tag{5}$$
Calculate the coefficient of determination of the regression, the R^2 and further denote the R_{old}^2.
2. Regression of Y_t on $1, x_1, x_2, ..., x_p$ and 2 additional predictors that $\hat{Y}_t^2$ and $\hat{Y}_t^3$ calculate the estimated values of the response variable $\hat{Y}_t$, so:
$$\hat{Y}_t = \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p \tag{6}$$
Calculate the coefficient of determination of the regression, the R^2 and further denote the R_{old}^2.
3. Calculate F test score
$$F = \frac{\left(R_{new}^2 - R_{old}^2\right)/m}{\left(1 - R_{new}^2\right)/\left(n - p - 1 - m\right)} \tag{7}$$
Where:

   m: additional predictors

   p: early predictors

   n: number of data in used
4. Based on the hypothesis of linearity, shows F test values approaching F distribution with degrees of freedom of m and (n-p-1-m). Conclusion Ho is rejected if F > F (α, m, n-p-1-m) or p-value < α (typically use the alpha value of 0.05).

B. White test

White test is non linearity detection test developed from neural models network raised by [7]. This test is included in the test group of type Lagrange Multiplier (LM). Hypothesis testing used in the test are the nonlinearitas:

$H_0 : f(X)$ is a linear function of the X or the linear model

$H_1 : f(X)$ is a nonlinear function of the X or the nonlinear model

H_0 is rejected, which means non-linear model is appropriate, if the value of the F test meets namely the rejection region

$$F > F_{\alpha;(df_1, df_2)} \text{ atau } p\text{-}value < \alpha$$

The following steps in the White test by [3]:

1. Regression of Y_t on $1, x_1, x_2, ..., x_p$, calculate the residual value $\hat{u}_t$ and calculate residual sum of squares:
$$SSR_0 = \sum \hat{u}_t^2 \tag{8}$$
2. Regression of Y_t on $1, x_1, x_2, ..., x_p$, m additional predictors so calculate residual $\hat{v}_t$ and calculate residual sum of squares:
$$SSR_1 = \sum \hat{v}_t^2 \tag{9}$$
3. Calculate F test score
$$F = \frac{\left(SSR_0 - SSR_1\right)/m}{SSR_1/\left(n - p - 1 - m\right)} \tag{10}$$
Where:

m: additional predictors

p: early predictors

n: number of data in used

4. Based on the hypothesis of linearity, shows F test values approaching F distribution with degrees of freedom of m and (n-p-1-m). Conclusion Ho is rejected if F > F (α, m, n-p-1-m) or p-value < α (typically use the alpha value of 0.05).

C. Terasvirta test

Terasvirta test included in the group Lagrange Multiplier (LM) test with a Taylor expansion approach that uses a test statistic χ^2 with degrees v. Terasvirta test procedure is described as follows [3]:

1. Regression of Y_t on $1, x_1, x_2, ..., x_p$, and calculate the residual value $\hat{u}_t$.
2. Regression of Y_t on $1, x_1, x_2, ..., x_p$, and m additional predictors which is the result of Taylor expansion approach.
3. Calculate the coefficient of determination (R^2) and regression in the previous step.
4. Calculate statistics test $\chi^2 = nR^2$ with n is number of data. Hypothesis testing used in the test are the nonlinearitas:

   $H_0 : f(X)$ is a linear function of the X or the linear model

   $H_1 : f(X)$ is a nonlinear function of the X or the nonlinear model
5. Based on the hypothesis of linearity, shows χ^2 test values approaching χ_V^2 distribution. Conclusion Ho is rejected if p-value from χ^2 test values < α (typically use the alpha value of 0.05).

IV. METHODOLOGY

Data used in this study are secondary data the number of foreign tourists at the airport Juanda obtained from BPS. Data used in this study is the monthly data, the period to be examined is January 2000 to December 2015. This study begins with a description of the data that will be used to determine the amount of data to be used as well as other descriptions of the data. Then the data will be plotted using a time series plot to show data on the number of foreign tourists pattern at Juanda airport and final testing will be performed on the data using nonlinear three nonlinearitas test is Ramsey's RESET test, White test adn Terasvirta test. This research using minitab program to descriptive data and time series plot, whereas for the non linearity test using the assistance program R.

V. RESULTS AND DISCUSSION

The first step in this research was to determine the amount of data on the number of foreign tourists at the airport Juanda started January 2000 to December 2015. The following description is shown in the table data to be used:

TABEL 1. DESCRIPTIVE STATISTICS

Variable	Total count	Mean	SE Mean	St Dev
Juanda	192	11923	330	4569

Based on Table 1, indicated that the data used in this study as many as 192 data with mean 11923 and stardard deviation 4569. Since determining much of the data used, the next step is to see patterns in the data on the number of foreign tourists. then be shown a pattern of data using time series plot in the figure below:

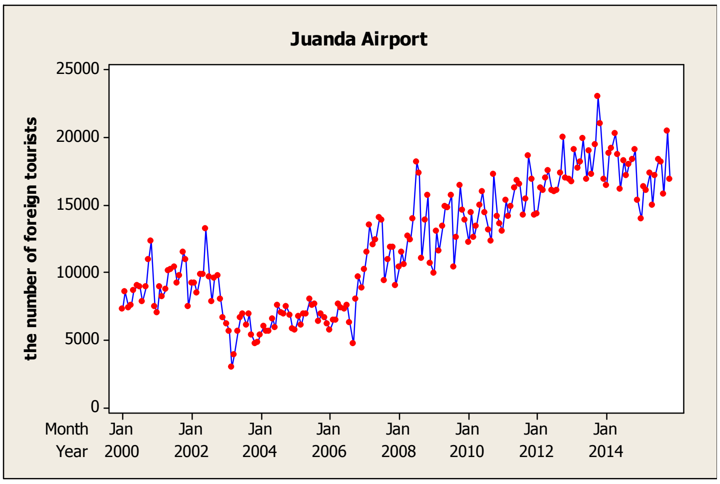

FIGURE 1. TIME SERIES PLOT OF JUANDA

Shown in Figure 1, data on the number of foreign tourists have a pattern that is up and down. The next will be tested for nonlinearitas because such data is not always a linear pattern. before conducting the test, will be determined in advance time series model to be used in testing. the model used in this study is a model AR (1), this model is a time series model with a univariate predictor variables. The following models of the AR (1) to be used in this study:

$$Y_t = Y_{t-1} \tag{11}$$

after determining the models to be tested, last step the model will be tested using three test program nonlinearitas using R. after the test is done using R obtained the following results:

```
#packages in used
library(lmtest)
library(tseries)

#Load Data
data=read.csv("d://wisman.csv",sep=";",header=T)
attach(data)

#Ramsey's RESET Test
model      = Yt~Yt.1
reset.test = reset(model, type='regressor',data=data)
reset.test$p.value


#Terasvirta Test
teras.test=terasvirta.test(x=Yt.1, y=Yt, type = "F",scale = T)
teras.test$p.value


#White Test
Whi.test=white.test(x=Yt.1, y=Yt, type = "Chisq",scale = T)
Whi.test$p.value
```

FIGURE 2. SYNTAX NONLINEARITY TEST

The syntax is obtained based on [2], with some simple changes. After the test is done using R obtained the following results:

```
> #Ramsey's RESET Test
> model      = Yt~Yt.1
> reset.test = reset(model, type='regressor',data=data)
> reset.test$p.value
[1] 0.01006504
>
>
> #Terasvirta Test
> teras.test=terasvirta.test(x=Yt.1, y=Yt, type = "F",scale = T)
> teras.test$p.value
[1] 0.009820545
>
>
> #White Test
> Whi.test=white.test(x=Yt.1, y=Yt, type = "Chisq",scale = T)
> Whi.test$p.value
[1] 0.007855382
```

FIGURE 3. RESULT NONLINEARITY TEST

Syntax in R is based on the steps [1], [7] and [3]. Based on the results of running using the R found that the three test produces a value less than the p-value of 0.05.Ramsey's RESET test the values obtained data on the number of foreign tourists at the airport juanda of 0.01006504, with a p-value of 0.05 so that it can be seen that the number of foreign tourists at the airport juanda smaller than the p-value. White test the values obtained data on the number of foreign tourists at the airport juanda of 0.009820545, with a p-value of 0.05 so that it can be seen that the number of foreign tourists at the airport juanda smaller than the p-value. Terasvirta test the values obtained data on the number of foreign tourists at the airport juanda of 0.007855382, with a p-value of 0.05 so that it can be seen that the number of foreign tourists at the airport juanda smaller than the p-value.

VI. CONCLUSIONS

Based on the results and discussions can be concluded that the time series data, especially data on the number of foreign tourists at Juanda airport is a nonlinear model. Because it is based on three trials showed nonlinearity p-value less than 0.05. as shown in the table below:

	Ramsey's RESET test	White test	Terasvirta test
p-value	0.01006504	0.009820545	0.007855382

After finding out that the time series data can be non-linear form, this data can be used for regression semiparametric or nonparametric regression.

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M – 16

Analyzing Of Bank Performance Level Using RGEC And Mamdani Fuzzy System Implemented With Graphical User Interface

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***Abstract*—**Banking industry has become an integral part in operating economic activities in every country. It is one of the most vibrant and growing industries of Indonesia. Analyzing of bank's performance helps them to evaluate and improve their weaker area and to know how far they have satisfied their customer. It also becomes one of the customers' considerations to choice their bank. This research is aimed at explaining how to apply Mamdani fuzzy system to determine the performance of banks in Indonesia and the system is implemented by using Graphical User Interface (GUI). The other aim of this research is to determine the accuracy of bank's performance using Mamdani fuzzy system. The first step is to determine the bank performance that is measured by using RGEC approach (Risk Profile, Good Corporate Governance, Earnings, Capital). The ratios that are used are Non Performing Loan (NPL), Loan to Deposit Ratio (LDR), Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Capital Adequacy Ratio (CAR). This research is quantitative descriptive research using secondary data. This research uses 109 banks' data with three years period. The data are divided into two parts which 87 banks are for training data and 22 banks are for testing data. The fuzzy system that is used is Mamdani method and we use the centroid method in defuzzification process. Then, the result of fuzzy system is implemented by using Graphical User Interface (GUI).The accuracy of the Mamdani fuzzy system for data training in 2011, 2012, 2013 is respectively 86.2%, 83.9%, 91.95%. The accuracy of testing data in 2011, 2012, 2013 is respectively 95.45%,100%, 100%. It means that the Mamdani fuzzy system can be applied to classify the bank performance in Indonesia.

Keywords: *bank performance, Graphical User Interface, RGEC, Mamdani fuzzy system.*

I. INTRODUCTION

Bank is an institution collecting fund from people in the form of deposit and distributing it to people in the form of credit in order to increase the their quality life. Banking industry has a vital role in improving the economic condition of a country [1]. It is because most of the life sectors related to finances need the banking service so that bank becomes the core of a country's economic matters.

Based on that statement, it is needed to know the performance of banks. Knowing the banks' performance is aimed at keeping the economic stability and becoming the customers' consideration in choosing a bank. Besides, it can be used by Bank Indonesia to supervise a bank. The method used to assess the performance of banks in Indonesia is RGEC method. This method contains the assessment of general bank performance level with the risk approach including the assessment of four factors. They are Risk Profile, Good Coorporate Governance, Earning, dan Capital [2].

There are several researches about banks performance that have been done which one of them is by Nadia Iffatul Ulya using RGEC method with Man-Whitney to compare 15 conventional banks to Islamic banks [3]. While, Uddin and Bristy use squared correlation coefficient method (r^2) to analyze five commercial banks in Bangladesh [4]. Then, Shen and Tzeng use DRSA (dominance-based rough set approach) method with Neural Network in the application of financial condition prediction of bank in Taiwan [5]. Nur Artyka uses RGEC method to assess the performance of PT. Bank Rakyat Indonesia in 2011-2013 [6]. Moreover, Anis Ulfah Mustaqim analyzes the performance of 107 banks in Indonesia by using CAMEL method with Mamdani fuzzy logic [7]. The last is a research conducted by Rani Mita Sari classifying the performances of banks in Indonesia with RGEC method and zero-order Sugeno fuzzy [8].

Fuzzy system can be interpreted as a complete linguistic description (the rule of fuzzy: if-then) that is about a process that can be combined into a model [9]. The phase of fuzzy system is fuzzification, fuzzy inference, and defuzzification. The fuzzy system can be applied into many kinds of field, such as: medical diagnose, control algorithm, decision supporting system, economic, technique, environment, psychology, and many more [10]. Mamdani's fuzzy inference method was among the first control systems built using fuzzy set theory. This research uses fuzzy system with Mamdani inference and and centroid defuzzification as the aids to make a decision in assessing the bank performance in Indonesia. Mamdani method is simple inference method because it has easy calculation and comprehension level [11]. Graphical User Interface (GUI) is used as the connector between the users and fuzzy system that is built to ease the users in operating it.

II. METHODS

The data is obtained from the file of Bank Indonesia and the website of Financial Service Authority. There are 109 banks' data that are collected. The data of those banking names are then given a code like 1, 2, 3,…,109 as the substitute of the names of the researched banks. This researched is conducted for three years so that it is collected 327 banks' data. The RGEC factor is only limited by the risk profile, earnings, and capital. The good corporate governance (GCG) factor is not analyzed because it is qualitative research done by the bank itself (self-assessment) and it is because there is not any data for that factor in the file of Bank Indonesia. The steps of the research are shown by Figure 1 as follows:

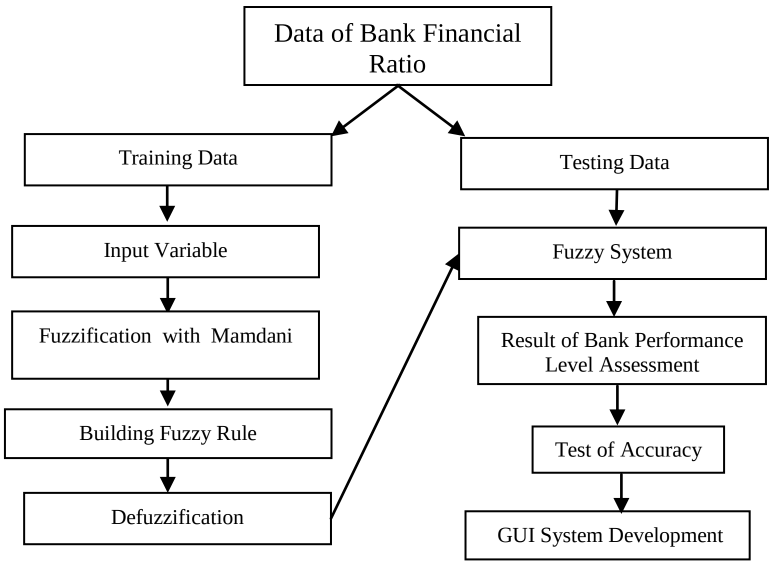

FIGURE 1. THE STEPS OF BANK PERFORMANCE LEVEL ASSESSMENT USING MAMDANI FUZZY SYSTEM

The first is looking for the ratio to measure the factors used in the RGEC method. Risk profile factor uses two ratio indicators i.e. Non Performing Loan (NPL) and Loan to Deposit Ratio (LDR). The earnings factor uses the ratio of Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM). Capital Adequacy Ratio (CAR) is used to analyze the Capital factor. The determination of NPL and LDR ranking can be seen on the Table 1.

TABLE 1. MATRIX OF RANKING DETERMINATION CRITERIA OF NPL AND LDR

Ranking	Information	NPL Criteria	LDR Criteria
1	Very good	NPL < 2%	LDR ≤ 75%
2	Good	2% ≤ NPL < 3,5%	75% < LDR ≤ 85%
3	Good enough	3,5% ≤ NPL < 5%	85% < LDR ≤ 100%
4	Less than good	5% ≤ NPL ≤ 8%	100% < LDR ≤ 120%
5	Not good	NPL > 8%	LDR > 120%

SOURCE : BUKU LAPORAN KEUANGAN [12] AND SURAT EDARAN BANK INDONESIAI [13]

The matrix of ranking determination criteria of Return on Assets (ROA) ratio, Return on Equity (ROE) ratio, and Net Interest Margin (NIM) is shown on the Table 2.

TABLE 2. MATRIX OF RANKING DETERMINATION CRITERIA OF ROE AND NIM

Ranking	Information	ROA Criteria	ROE Criteria	NIM Criteria
1	Very good	ROA > 1,5%	ROE > 20%	NIM > 5%
2	Good	1,25% < ROA ≤ 1,5%	12,51% ≤ ROE ≤ 20%	2.01% ≤ NIM ≤ 5%
3	Good enough	0,5% < ROA ≤ 1,25%	5,01% ≤ ROE ≤ 12,5%	1.51% ≤ NIM ≤ 2%
4	Less than good	0% < ROA ≤ 0,5%	0% ≤ ROE ≤ 5%	0% ≤ NIM ≤ 1.49%
5	Not good	ROA ≤ 0%	ROE < 0%	NIM < 0%

SOURCE: LAMPIRAN II SURAT EDARAN BANK INDONESIA [14] AND SURAT EDARAN BANK INDONESIA [13]

Standart rasio Capital Adequacy Ratio(CAR) can be seen on the Table 3.

TABLE 3. MATRIX OF RANKING DETERMINATION CRITERIA OF CAPITALIZATION

Ranking	Information	Criteria
1	Very good	KPMM > 12%
2	Good	9% < KPMM ≤ 12%
3	Good enough	8% < KPMM ≤ 9%
4	Less than good	6% < KPMM ≤ 8%
5	Not good	KPMM ≤ 6%

SOURCE : SURAT EDARAN BANK INDONESIA [13]

III. RESULTS AND DICUSSION

The first step in assessing the bank performance is looking for each bank's performance by using RGEC method. The performance level of a bank is known through the composite level it has, using the criteria that has been determined on the Table 1, Table 2, and Table 3. After the whole ratio data are collected, the next step is classifying each RGEC ratio into several composite ranks so that it can be determined its own score.

For example is the financial ratio data of the bank code 3 in 2011. The ratio can be classified into suitable composite ranking as it reflected on the Table 4.

TABLE 4. RATIO COMPOSITE RANKING OF BANK CODE 3 YEAR OF 2011

RGEC Ratio	Ratio Value	Composit Ranking
NPL	3,55	3 (very good)
LDR	65,79	1 (very good)
ROA	1,39	2 (very good)
ROE	11,39	3 (very good)
NIM	4,54	2 (very good)
CAR	16,39	1 (very good)

After the result of performance level ranking determination on each RGEC factor is gained, the score is defined to determine the final composite ranking of a bank.

TABLE 5. PERFORMANCE LEVEL OF BANK CODE 3 YEAR OF 2013

RGEC Ratio	Composite Ranking	Score
NPL	3	3
LDR	1	5
ROA	2	4
ROE	3	3
NIM	2	4
CAR	1	5
Total of Score		24

The score total gained by bank code 3 is 24. It means that the bank can be categorized into composite ranking 2 or it shows that the condition of bank 3 is good in general so that the bank is assumed to be able to face the significant negative impacts form the change of business condition or the other external factors.

Based on that performance assessment, the next step can be done that is building the fuzzy system. The followings are the steps of building the Mamdani fuzzy system.

A. Identifying the Set of Universal (U) on the Input and Output

Universal set is the value allowed in fuzzy system operation. There are 87 training data that are used with three years period so that the total of training data is 261 data. Here are the universal set on the input variable: $U_{\text{NPL}} = [0, 13]$, $U_{\text{LDR}} = [0, 621]$, $U_{\text{ROA}} = [-2, 8]$, $U_{\text{ROE}} = [-20, 144]$, $U_{\text{NIM}} = [-2, 21]$, and $U_{\text{CAR}} = [0, 182]$. The universal set on the output is $U_{\text{output}} = [0\ 31]$.

B. Identifying Fuzzy Set on the Input and Output

In this step, the clear set will be transformed into fuzzy set. The process is named fuzzification process. The fuzzy set is transformed by using affiliation function. The affiliation function used on the input of this research is the affiliation function of shoulder curve approach with the combination of affiliation function of triangle and trapezium.

Input variable can be defined into five fuzzy set with the affiliation function of shoulder curve approach. Fuzzy set for bank that have composite ranking 1 given a code SS, composite ranking 2 given code S, composite ranking 3 given code CS, composite ranking 4 given code KS, and composite ranking 5 given code TS. The equation shoulder curve on the NPL and LDR ratio is as follows:

$$\mu_{\text{NPL}_{\text{SS}}}(x) = \begin{cases} 1 & ; 0 \le x \le 1{,}5 \\ -x + 2{,}5 & ; 1{,}5 \le x \le 2{,}5 \\ 0 & ; x \ge 2{,}5 \end{cases}$$

$$\mu_{\text{NPL}_{\text{S}}}(x) = \begin{cases} 1 & ; x \le 1{,}5 \text{ or } x \ge 4{,}5 \\ x - 1{,}5 & ; 1{,}5 \le x \le 2{,}5 \\ \frac{4{,}5 - x}{2} & ; 2{,}5 \le x \le 4{,}5 \end{cases}$$

$$\mu_{\text{NPL}_{\text{CS}}}(x) = \begin{cases} 0 & ; x \le 2{,}5 \text{ or } x \ge 5{,}5 \\ \frac{x - 2{,}5}{2} & ; 2{,}5 \le x \le 4{,}5 \\ 5{,}5 - x & ; 4{,}5 \le x \le 5{,}5 \end{cases}$$

$$\mu_{\text{NPL}_{\text{KS}}}(x) = \begin{cases} 0 & ; x \le 4{,}5 \text{ or } x \ge 10{,}5 \\ x - 4{,}5 & ; 4{,}5 \le x \le 5{,}5 \\ \frac{10{,}5 - x}{5} & ; 5{,}5 \le x \le 10{,}5 \end{cases}$$

$$\mu_{\text{NPL}_{\text{TS}}} = \begin{cases} 0 & ; x \le 5{,}5 \\ \dfrac{x - 5{,}5}{5} & ; 5{,}5 \le x \le 10{,}5 \\ 1 & ; 10{,}5 \le x \le 13 \end{cases}$$

and

$$\mu_{\text{LDR}_{\text{SS}}}(x) = \begin{cases} 1 & ; 0 \le x \le 70 \\ \dfrac{80 - x}{10} & ; 70 \le x \le 80 \\ 0 & ; x \ge 80 \end{cases}$$

$$\mu_{\text{LDR}_{\text{S}}}(x) = \begin{cases} 0 & ; x \le 70 \text{ or } x \ge 90 \\ \dfrac{x - 70}{10} & ; 70 \le x \le 80 \\ \dfrac{90 - x}{10} & ; 80 \le x \le 90 \end{cases}$$

$$\mu_{\text{LDR}_{\text{CS}}}(x) = \begin{cases} 0 & ; x \le 80 \text{ or } x \ge 110 \\ \frac{x - 80}{10} & ; 80 \le x \le 90 \\ \frac{110 - x}{20} & ; 90 \le x \le 110 \end{cases}$$

$$\mu_{\text{LDR}_{\text{KS}}}(x) = \begin{cases} 0 & ; x \le 90 \text{ or } x \ge 130 \\ \frac{x - 90}{20} & ; 90 \le x \le 110 \\ \frac{130 - x}{20} & ; 110 \le x \le 130 \end{cases}$$

$$\mu_{\text{LDR}_{\text{TS}}}(x) = \begin{cases} 0 & ; x \le 110 \\ \frac{x - 110}{20} & ; 110 \le x \le 130 \\ 1 & ; 130 \le x \le 621 \end{cases}$$

The representation of fuzzy set on the input variable of NPL ratio and LDR ratio can be seen on the Figure 2 and Figure 3.

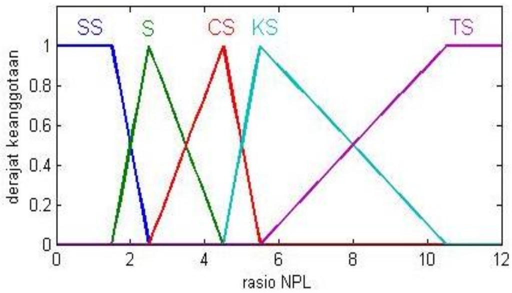

FIGURE 2. FUZZY SET IN NPL VARIABLE

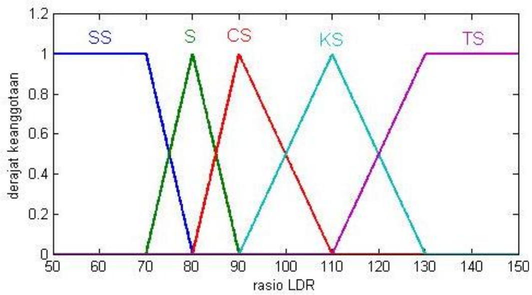

FIGURE 3. FUZZY SET IN LDR VARIABLE

The shoulder curve equation on the ROA ratio and ROE ratio is as follows:

$$\mu_{\text{ROA SS}} = \begin{cases} 0 & ; x \le 1{,}4 \\ \dfrac{x - 1{,}4}{0{,}2} & ; 1{,}4 \le x \le 1{,}6 \\ 0 & ; 1{,}6 \le x \le 8 \end{cases}$$

$$\mu_{\text{ROE SS}}(x) = \begin{cases} 0 & ; x \le 17{,}5 \\ \dfrac{x - 17{,}5}{5} & ; 17{,}5 \le x \le 22{,}5 \\ 1 & ; 22{,}5 \le x \le 143 \end{cases}$$

$$\mu_{ROA\ S}(x) = \begin{cases} 0 & ; x \le 1{,}1 \text{ or } x \ge 1{,}6 \\ \dfrac{x - 1{,}1}{0{,}3} & ; 1{,}1 \le x \le 1{,}4 \\ \dfrac{1{,}6 - x}{0{,}2} & ; 1{,}4 \le x \le 1{,}6 \end{cases}$$

$$\mu_{ROA\ CS}(x) = \begin{cases} 0 & ; x \le -0{,}1 \text{ or } x \ge 1{,}4 \\ \frac{x+0{,}1}{1{,}2} & ; -0{,}1 \le x \le 1{,}1 \\ \frac{1{,}4-x}{0{,}3} & ; 1{,}1 \le x \le 1{,}4 \end{cases}$$

$$\mu_{ROA\ KS}(x) = \begin{cases} 0 & ; x \le -0{,}2 \text{ or } x \ge 1{,}1 \\ \frac{x+0{,}2}{0{,}1} & ; -0{,}2 \le x \le -0{,}1 \\ \frac{1{,}1-x}{1{,}2} & ; -0{,}1 \le x \le 1{,}1 \end{cases}$$

$$\mu_{ROA_{TS}}(x) = \begin{cases} 1 & ; -2 \le x \le -0{,}2 \\ \frac{-x-0{,}1}{0{,}1} & ; -0{,}2 \le x \le -0{,}1 \\ 0 & ; x \ge -0{,}1 \end{cases}$$

And

$$\mu_{ROE_S}(x) = \begin{cases} 0 & ; x \le 7{,}5 \text{ or } x \ge 22{,}5 \\ \frac{x-7{,}5}{10} & ; 7{,}5 \le x \le 17{,}5 \\ \frac{22{,}5-x}{5} & ; 17{,}5 \le x \le 22{,}5 \end{cases}$$

$$\mu_{ROE_{CS}}(x) = \begin{cases} 0 & ; x \le 2{,}5 \text{ or } x \ge 17{,}5 \\ \frac{x-2{,}5}{5} & ; 2{,}5 \le x \le 7{,}5 \\ \frac{17{,}5-x}{10} & ; 7{,}5 \le x \le 17{,}5 \end{cases}$$

$$\mu_{ROE_{KS}}(x) = \begin{cases} 0 & ; x \le -2{,}5 \text{ or } x \ge 7{,}5 \\ \frac{x+2{,}5}{5} & ; -2{,}5 \le x \le 2{,}5 \\ \frac{7{,}5-x}{5} & ; 2{,}5 \le x \le 7{,}5 \end{cases}$$

$$\mu_{ROE_{TS}}(x) = \begin{cases} 1 & ; -20 \le x \le -2{,}5 \\ \frac{2{,}5-x}{5} & ; -2{,}5 \le x \le 2{,}5 \\ 0 & ; x \ge 2{,}5 \end{cases}$$

The representation of fuzzy set on the input variable of ROE ratio and ROE ratio can be seen on the Figure 4 and Figure 5.

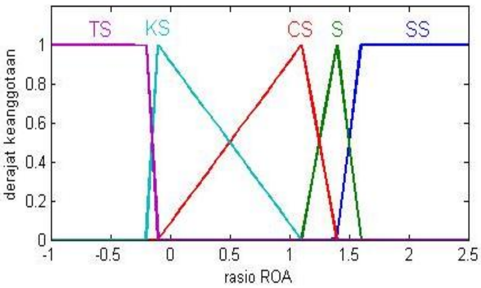

FIGURE 4. FUZZY SET IN ROA VARIABLE

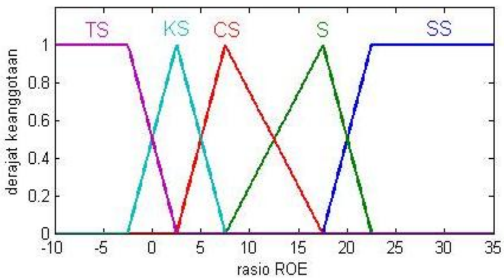

FIGURE 5. FUZZY SET IN ROE VARIABLE

The shoulder curve equation on the ROA ratio and ROE ratio is as follows:

$$\mu_{NIM_{SS}}(x) = \begin{cases} 0 & ; x \le 2{,}25 \\ \frac{x-2{,}25}{5{,}5} & ; 2{,}25 \le x \le 7{,}75 \\ 1 & ; 7{,}75 \le x \le 21 \end{cases}$$

$$\mu_{NIM_S}(x) = \begin{cases} 0 & ; x \le 1{,}75 \text{ or } x \ge 7{,}75 \\ \dfrac{x - 1{,}75}{0{,}5} & ; 1{,}75 \le x \le 2{,}25 \\ \dfrac{7{,}75 - x}{5{,}5} & ; 2{,}25 \le x \le 7{,}75 \end{cases}$$

$$\mu_{NIM_{CS}}(x) = \begin{cases} 0 & ; x \le 1{,}25 \text{ or } x \ge 2{,}25 \\ \dfrac{x - 1{,}25}{0{,}5} & ; 1{,}25 \le x \le 1{,}75 \\ \dfrac{2{,}25 - x}{0{,}5} & ; 1{,}75 \le x \le 2{,}25 \end{cases}$$

$$\mu_{NIM_{KS}}(x) = \begin{cases} 0 & ; x \le -1{,}25 \text{ or } x \ge 1{,}75 \\ \frac{x+1{,}25}{2{,}5} & ; -1{,}25 \le x \le 1{,}25 \\ \frac{1{,}75-x}{0{,}5} & ; 1{,}25 \le x \le 1{,}75 \end{cases}$$

And

$$\mu_{CAR\ SS}(x) = \begin{cases} 0 & ; x \le 9{,}5 \\ \dfrac{x - 9{,}5}{5} & ; 9{,}5 \le x \le 14{,}5 \\ 1 & ; 14{,}5 \le x \le 182 \end{cases}$$

$$\mu_{CAR\ S}(x) = \begin{cases} 0 & ; x \le 8{,}5 \text{ or } x \ge 14{,}5 \\ x - 8{,}5 & ; 8{,}5 \le x \le 9{,}5 \\ \dfrac{14{,}5 - x}{5} & ; 9{,}5 \le x \le 14{,}5 \end{cases}$$

$$\mu_{CAR\ CS}(x) = \begin{cases} 0 & ; x \le 7{,}5 \text{ or } x \ge 9{,}5 \\ x - 7{,}5 & ; 7{,}5 \le x \le 8{,}5 \\ 9{,}5 - x & ; 8{,}5 \le x \le 9{,}5 \end{cases}$$

$$\mu_{CAR\ KS}(x) = \begin{cases} 0 & ; x \le 4{,}5 \text{ or } x \ge 8{,}5 \\ \dfrac{x - 4{,}5}{3} & ; 4{,}5 \le x \le 7{,}5 \\ 8{,}5 - x & ; 7{,}5 \le x \le 8{,}5 \end{cases}$$

$$\mu_{CAR\ TS}(x) = \begin{cases} 1 & ; 0 \le x \le 4{,}5 \\ \dfrac{7{,}5 - x}{3} & ; 4{,}5 \le x \le 7{,}5 \\ 0 & ; x \ge 7{,}5 \end{cases}$$

$$\mu_{NIM_{TS}}(x) = \begin{cases} 1 & ; -2 \le x \le -1{,}25 \\ \frac{1{,}25 - x}{2{,}5} & ; -1{,}25 \le x \le 1{,}25 \\ 0 & ;\ x \ge 1{,}25 \end{cases}$$

The representation of fuzzy set on the input variable of ROE ratio and ROE ratio can be seen on the Figure 6 and Figure 7.

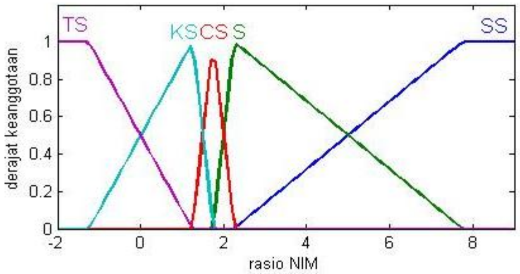

FIGURE 6. FUZZY SET IN INPUT VARIABLE

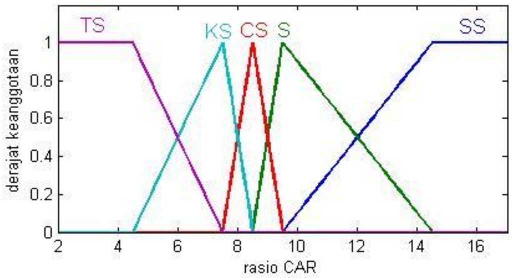

FIGURE 7. FUZZY SET IN INPUT VARIABLE

Output variable is also represented by shoulder curve approach. The value of RGEC ratio has output not good (TS), less than good (KS), good enough (CS), sehat (S), dan very good (SS) with the affiliation function as follows:

$$\mu_{output_{SS}}(x) = \begin{cases} 0 & ; x \le 24{,}5 \\ \dfrac{x - 24{,}5}{6} & ; 24{,}5 \le x \le 30{,}5 \\ 1 & ; 30{,}5 \le x \le 31 \end{cases}$$

$$\mu_{output_{S}}(x) = \begin{cases} 0 & ; x \le 18{,}5 \text{ or } x \ge 30{,}5 \\ \dfrac{x - 18{,}5}{6} & ; 18{,}5 \le x \le 24{,}5 \\ \dfrac{30{,}5 - x}{6} & ; 24{,}5 \le x \le 30{,}5 \end{cases}$$

$$\mu_{output_{CS}}(x) = \begin{cases} 0 & ; x \le 9{,}5 \text{ or } x \ge 24{,}5 \\ \dfrac{x - 9{,}5}{9} & ; 9{,}5 \le x \le 18{,}5 \\ \dfrac{24{,}5 - x}{6} & ; 18{,}5 \le x \le 24{,}5 \end{cases}$$

$$\mu_{output_{KS}}(x) = \begin{cases} 0 & ; x \le 3{,}5 \text{ or } x \ge 18{,}5 \\ \dfrac{x - 3{,}5}{6} & ; 3{,}5 \le x \le 9{,}5 \\ \dfrac{18{,}5 - x}{9} & ; 9{,}5 \le x \le 18{,}5 \end{cases}$$

$$\mu_{output_{TS}}(x) = \begin{cases} 1 & ; 0 \le x \le 3{,}5 \\ \dfrac{9{,}5 - x}{6} & ; 3{,}5 \le x \le 9{,}5 \\ 0 & ;\ x \ge 9{,}5 \end{cases}$$

The fuzzy set on the output variable can be seen on the Figure 8.

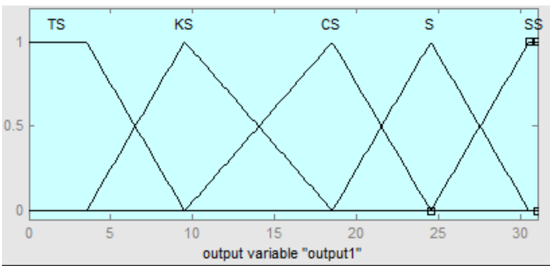

FIGURE 8. FUZZY SET IN OUTPUT VARIABLE

C. Determining Fuzzy Rule

The performance assessment result used in determining fuzzy rule comes form the total of training data of which the total is 261. The fuzzy rule that has been made is sequenced and selected. If there are several same rules, then it is only one that is chosen whereas the other ones are eliminated. The performance level of bank code 3 with the RGEC method has good output. For example is the bank code 3 in 2011 of which the NPL ratio value is 3,55, LDR ratio value is 65,79, ROA ratio value is 1,39, ROE ratio value is 11.39, NIM ratio value is 4,54, and CAR ratio value is 16,39. Then, the fuzzy rule is looked for based on those data. That ratio value is reckoned as *x* value. Based on the five fuzzy set defined on the NPL variable, the NPL affiliation degree can be then known. The function of combination basic operation is used to choose the biggest affiliation degree of those five affiliation degree [15].

$$\begin{aligned} \mu A\cup B\ (x) &= \max[\mu A(x), \mu A(x)], \forall x \in U \qquad (1)\\ &= \max[0; 0{,}475; 0{,}525; 0; 0]\\ &= 0{,}525. \end{aligned}$$

The NPL affiliation degree of bank code 112 in 2011 is 0,525 so that the NPL ratio can be classified into the set of fuzzy NPL_3 or good enough. Do the same thing to the other ratio factors so that it will be created a fuzzy rule i.e. "If NPL is NPL_3 (good enough) and LDR is LDR_1 (very good) and ROA is ROA_2 (good) and ROE is ROE_3 (good enough) and NIM is NIM_2 (good) and CAR is CAR_1 (very good), then the result of bank assessment is good. Furthermore, do the same thing to 260 other banks so that it will be created 141 fuzzy rules as follows.

1 If NPL is VERY GOOD and LDR is VERY GOOD and ROA is VERY GOOD and ROE is VERY GOOD and NIM is VERY GOOD and CAR is VERY GOOD so that the bank assessment is VERY GOOD"

2 If NPL is VERY GOOD and LDR is VERY GOOD and ROA is VERY GOOD and ROE is VERY GOOD and NIM is VERY GOOD and CAR is GOOD so that the bank assessment is VERY GOOD"

3 If NPL is VERY GOOD and LDR is VERY GOOD and ROA is VERY GOOD and ROE is VERY GOOD and NIM is GOOD ENOUGH and CAR is GOOD so that the bank assessment is VERY GOOD"

. .
. .
. .

115 If NPL is GOOD ENOUGH and LDR is VERY GOOD and ROA is SEHAT and ROE is GOOD ENOUGH and NIM is GOOD and CAR is VERY GOOD so that the bank assessment is GOOD"

. .
. .
. .

141 If NPL is LESS THAN GOOD and LDR is GOOD and ROA is NOT GOOD and ROE is NOT GOOD and NIM is VERY GOOD and CAR is GOOD so that the bank assessment is GOOD ENOUGH"

D. Fuzzy Sytsem Inference with Mamdani Method

Mamadani method or *min-max inferencing* uses implication function min or AND and rule aggregation max or OR. The aggregation of fuzzy rule can be searched by using the formula as follows.

$$\mu_{B^k}(y)=\max_k[\min[\mu A_1^k(xi),\mu A_2^k(xj)]] \qquad (2)$$

For k = 1,2, . . n, $A_1^k$and A_2^kstates that antecendent pair fuzzy set is number- k, and B^k is a consequent fuzzy set number- k. [16]. For example, bank code 3 has been looked for its own biggest affiliation degree. That affiliation degree forms a fuzzy rule. According to that rule, it can be looked its implication value. The implication value can be looked by determining the minimum value using piece basic operation that is reflected by the Equation (3) [15].

$$\begin{aligned} \mu A\cap B\ (x) &= \min[\mu A(x), \mu A(x)], \forall x\in U \qquad (3)\\ &=\min(0{,}525;1; 0{,}967; 0{,}611; 0{,}583;1)\\ &= 0{,}525 \end{aligned}$$

TABLE 6. IMPLICATION FUCNTION RESULT OF BANK CODE 3 IN 2011

Rules	NPL	LDR	ROA	ROE	NIM	CAR	Implikacation α_n
1	0,525	1	0,967	0,611	0,583	1	0,525
2	0,525	1	0,967	0,611	0,583	0	0
..	...	...	...	...	...	...	...
141	0	0	0	0	0,416	0	0

By using the equation (2), it is known that the aggregation value of bank code 3 in 2011 is 0,525. The rules composition result for the bank code 3 in 2011 is shown by the FIGURE 3.

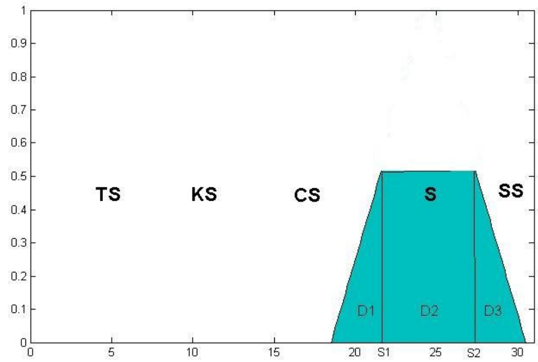

FIGURE 9. The Area of Rules Composition Result of Bank Code 3

Based on that calculation, it is gained that the affiliation function for the rules composition result of bank code 3 is.

$$\mu(x) = \begin{cases} \frac{x-18,5}{6};\ 18,5 \le x \le 21,65 \\ 0,525;\quad 21,65 \le x \le 27,35 \\ \frac{30,5-x}{6}; 27,35 \le x \le 30,5 \end{cases} \tag{4}$$

E. Fuzzy System Defuzzification

Deffuzifiaction is aimed at gaining the clear value on the output. The calculation of Centroid defuzzification can be done by using the equation (5) as follows.

$$D^* = \frac{\int_x \ x\,\mu_B(x)\ dx}{\int_x \ \mu_B(x)\ dx} \tag{5}$$

Then, the Equation (4) is gotten defuzzification with the Equation (5)

$$D^* = \frac{\int_{18,5}^{21,65} x\left(\frac{x-18,5}{6}\right)dx + \int_{21,65}^{27,35} x(0,525)dx + \int_{27,35}^{30,5} x\left(\frac{30,5-x}{6}\right)dx}{\int_{18,5}^{21,65}\left(\frac{x-18,5}{6}\right)dx + \int_{21,65}^{27,35}(0,525)dx + \int_{27,35}^{30,5}\left(\frac{30,5-x}{6}\right)dx}$$

$$= \frac{\frac{1}{6}\left[\frac{x^3}{3} - 9,25x^2\right]_{18,5}^{21,65} + 0,525\left[\frac{x^2}{2}\right]_{21,65}^{27,35} + \frac{1}{6}\left[15,25x^2 - \frac{x^3}{3}\right]_{27,35}^{30,5}}{\frac{1}{6}\left[\frac{x^2}{2} - 18,5x\right]_{18,5}^{21,65} + 0,525[x]_{21,65}^{27,35} + \frac{1}{6}\left[30,5x - \frac{x^2}{2}\right]_{27,35}^{30,5}}$$

$$= \frac{113,83}{4,647} = 24,495$$

According to that calculation, the value of D*=24,495. It shows that the bank code 3 in 2011 can be categorized into *good* classification or composite ranking 2. Then, the steps having been done can be applied to the whole training and testing data and it will be gained the bank performance assessment result which uses Mamdani fuzzy system. The result of fuzzy system on the training data can be seen on the Table 7 and the testing data can be seen on the Table 8.

TABLE 7. THE RESULT OF FUZZY SYSTEM ON THE TRAINING DATA IN 2011

No	Bank Code	Assessment of Bank Performance		
		y*	***Fuzzy System***	**RGEC Assessment**
1	1	28,5	Very good	Very good
2	2	27,3	Very good	Very good
...	...	...	...	...
261	87	24,5	Good	Good

TABLE 8. THE RESULT OF FUZZY SYSTEM ON THE TESTING DATA IN 2011

No	Bank Code	Assessment of Bank Performance		
		y*	***Fuzzy System***	**RGEC Assessment**
1	88	28,8	Very good	Very good
2	89	28,5	Very good	Very good
...	...	...	...	...
66	109	24,5	Good	Good

The accuracy of the fuzzy system that has been created is then examined. The accuracy level is obtained from the comparison between the fuzzy system and the assessment with RGEC.

$$\text{Accuracy} = \frac{\text{Total of correct data}}{\text{Total of incorrect data}} \text{x}100\% \tag{6}$$

The correct data is the data producing the same assessment between the fuzzy system and the assessment of RGEC whereas the incorrect data is the data producing different assessment between the fuzzy system and the assessment with RGEC.

From the whole data compared, there are 12 incorrect assessments in 2011, 14 data that are not same in 2012, and seven incorrect data in 2013. The accuracy value of training data in 2011, 2012, 2013 is respectively 86,2%, 83,9% and 91,95%. In the testing data year of 2011, there is one data producing different assessment and in the year of 2012 and 2013, the whole data produce the same assessment between the fuzzy system and the assessment of RGEC. The accuracy value of testing data in 2011, 2012, 2013 is respectively 95,45%, 100% and 100%. Thus, the Mamdani fuzzy system having been created by using fuzzy inference system can be used to assess the performance of banks in Indonesia.

The fuzzy system is then implemented on the graphical user interface (GUI). It is aimed at easing the users in applying the fuzzy system having been created. The result of fuzzy system implementation having been created can be seen on the Figure 10.

FIGURE 10 . VIEWING FUZZY

The GUI system as it is shown above begins with processing the data inputted manually. The data which have been inputted into GUI system is then processed to be classified into composite ranking based on the rule having been made by Bank Indonesia. The assessment result of bank performance on the GUI represents the assessment on the fuzzy system having been created. It means that the assessment result and the level of GUI accuracy are the same with the result of the fuzzy system.

IV. Conclusion

A. Conclusion

The implementation of Mamdani fuzzy system in assessing the level of banks' performance in Indonesia starts form dividing the data into 87 banks as training and 22 banks as testing. In this research, the input that is used consisting of NPL, LDR, ROA, ROE, NIM and CAR which each of them use shoulder curve representation. The output result of fuzzy system shows that category of bank performance assessment level is not good, less than good, good enough, good dan very good. There are 141 rules having been created. Fuzzy inference is conducted by using Mamdani system with defuzzification is centroid method. The assessment result with Mamdani fuzzy system is then compared to the classification result based on the RGEC calculation. The result is used to calculate the system accuracy level. The last, the fuzzy system having been created is implemented with Grapichal User Interface (GUI).

The accuracy level gained on the fuzzy system for the training data in 2011, 2012, 2013 is 86,2%, 83,9% dan 91,95%. In the testing data, the accuracy value in 2011, 2012 dan 2013 is respectively 95,45%, 100% dan 100%. Based on the accuracy result that is gained, it can be concluded that Mamdani fuzzy system with Centroid defuzzification and that is implemented with Grapichal User Interface (GUI) is good to be used in assessing the performance level of banks in Indonesia.

B. Suggestions

The result of this research is still far from being perfect. Accordingly, it is still needed to add the newest relevant data and there are several things of the system that still have to be evaluated. The improvement and correction that can be done is adding the total of banking financial ratio data, adding the input variable total, conducting a test with various kinds of affiliation function for each input, inference system and fuzzy defuzzification system method as well as using the other inference methods such as zero-order Tsukamoto Sugeno and zero-order Sugeno.

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M – 17

Analysis Propensity Score with Structural Equation Model Partial Least Square

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Abstract— In research of epidemiology, structural equation modeling (SEM) has been become very popular, especially for latent variables. In SEM there are assumptions that must include the data should be normally distributed multivariate and a used large of data. For overcome these problems required the alternative approach of SEM based variance or partial least square (PLS). SEM-PLS does not require an assumption that a lot. In health sector randomization is not possible, because it concerns the lives of humans. So that assumptions independent can't be achieved. This can lead to imbalances covariates and selection bias. Therefore, to overcome these problems applied propensity score (PS). This method is a statistical analysis that can be used to analyze study design Non-Experimental where can't do randomization to treatment groups. Furthermore, as suggested new methods for handling selection bias is a marginal meanweighting through stratification (MMW-S). The analysis result obtained when using MMW-S is powerful because MMWS show strong reduction in of selection bias. The author uses an innovative method by using empirical data HIV/AIDS. Briefly using MMW-S with a predisposition, clinical manifestations, and opportunistic infection. And adherence to antiretroviral (ARV) as a confounding variable. The results showed that the method of MMW-S can removed bias more than 93.5%.

Keywords: *SEM-PLS, Propensity score, MMW-S, HIV/AIDS*

I. INTRODUCTION

Health problems are one of the factors that have an important role in creating quality human resources. In health, SEM has become a very popular method mainly used to examine the Latent variables. Non-Experimental studies or observational studies are empirical investigations of the effects caused by the treatment as randomized experiments Randomized Controlled Trials (RCT) is impossibble [1]. In general, RCT is very required in the research to the independence assumption so that the bias selection can be minimized. However, in the field of health research involving human, RCT is not always practicable. One method is suggested to be used for such problems is propensity score. Once the propensity score has been estimated in a given dataset, a data preprocessing procedure is performed to create comparability between study groups, it is referred to as pre-processing because it is performed before the final treatment effect is estimated, thus replicating the RCT by separating the study design stage from the outcomes analysis [2].

In general, this first entails stratifying the analytic sample into quantiles of the propensity score, and then generating a weight for each individual based on their corresponding stratum and treatment assignment, the stratification reduces bias in the observed covariates used to create the propensity score, and the weighting standardizes each treatment group to the target population [3]. This approach namely marginal mean weighting through stratification (MMWS), can handle a broad array of experimental conditions that researchers will likely encounter in evaluating health care interventions Once generated, the MMWS can then be used within the appropriate outcome model to estimate unbiased treatment effects [3].

II. LITERATURE REVIEW

A. *Structural Equation Modeling Partial Least Square (SEM-PLS)*

SEM-based variance or based components called as partial least square (PLS) is a method of analysis that is powerful and often referred to as soft modeling because it does not require assumptions such as data should not normally distributed multivariate, can be used with data of nominal, ordinal, interval and ratio, in addition sample should not be large [4]. SEM-PLS consists of three components are outer model is specifies the relationship between variables latent and indicators or manifest variables (measurement model), inner model is specifies the relationship between the latent variables (structural model), and the weight relation.

PLS is a powerful modeling methods due to not assume the data must be with particular scale of measurement, samples should not be large, not require extremely assumptions. Types of indicators on the PLS are two as follows:

- Reflective indicators tend to be influenced by the latent variables (indicators is a reflection of the latent variables).
- Formative indicators tend to affect the latent variables (indicators are descriptors of latent variables).

Algorithm SEM-PLS as explained by [5], can be illustrated by Figure 1.

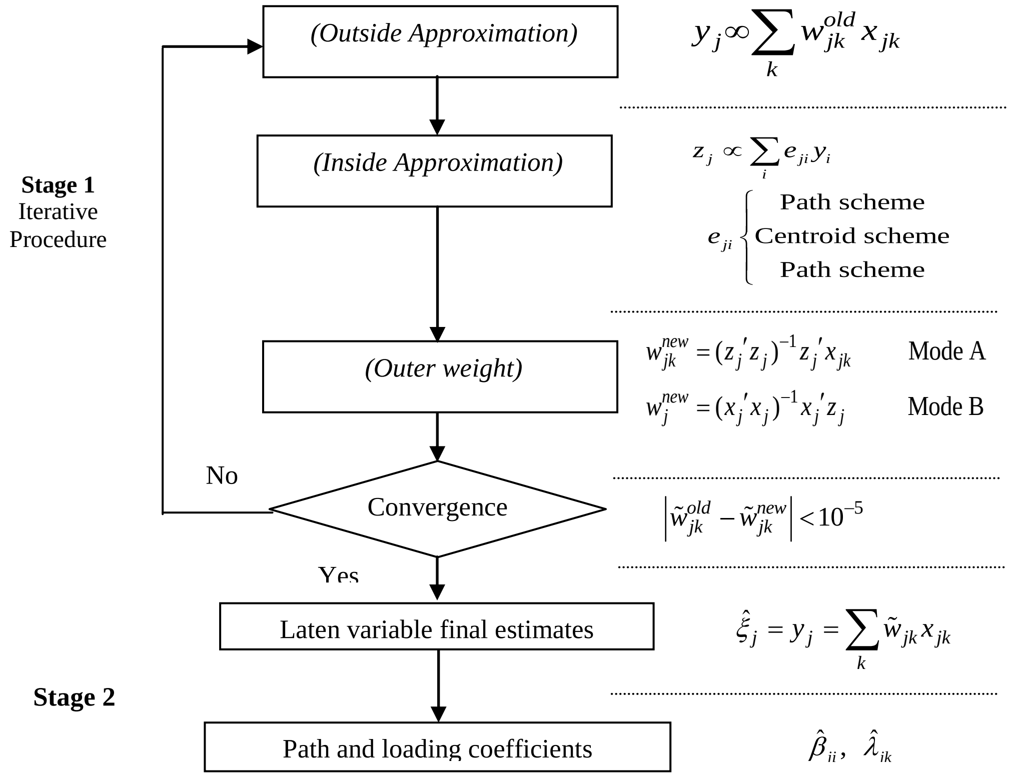

FIGURE 1. PLS ALGORITHM

Evaluation of PLS models is testing the validity and reliability. Validity testing performed to see the value of loading factor produced more than 0.5, if there are indicators has value loading factor below 0.5, then the are excluded from the analysis. Reliability testing show the composite value of each latent variable [6].

B. Propensity Score

The advantage of propensity score in comparison to multivariable adjustment is the separation of confounding factors adjustment and analysis of the treatment effect [7]. If the vector has many covariates were presented in many dimensions, then the propensity score can reduce all the dimensions into one dimension scores [2]. Rosenbaum and Rubin defined the propensity score for $i = 1, 2, \cdots, n$ as a conditional probability of being treated. Indicator of treatment group $(Z_i = 1)$ and control unit $(Z_i = 0)$ based on observed covariates vector (ξ_i). Propensity score can be written mathematically as follows:

$$e(\xi_i) = \mathrm{P}(Z_i = 1 | \xi_i) \tag{1}$$

The goal of propensity scoring is to balance the treated and untreated groups on the confounding factors that affect both the treatment assignment and the outcome, thus it is important to verify that treated and untreated patients with similar propensity score values are balanced on the factors included in the propensity score. Demonstrating that the propensity score achieves balance is more important than showing that the propensity score model has good discrimination [8].

C. Marginal Mean Weigthing through Stratification (MMWS)

Marginal mean weighting through stratification (MMW-S) was introduced as a flexible approach, combining propensity score weighting and propensity score stratification to remove imbalances of pre-intervention characteristics between two or more groups [3]. MMW-S produces more robust analysis than the methods of propensity score matching, propensity score stratification, and propensity score weighting [9].

$$MMWS = \frac{n_q \times \Pr(Z = z)}{n_{z=z,q}} \tag{2}$$

Where

n_q	= Number of individuals in each stratum
Pr(Z=z)	= Probability of the treatment group
$n_{z=z,q}$	= Number of individuals in each stratum is treated as treated / non-treated

D. HIV/AIDS

Human Immunodeficiency Virus (HIV) is a virus that reduces the body's immune system so that the people affected by this virus will be susceptible to various infections and then causes *Acquired Immune Deficiency Syndrome* (AIDS) [10]. The HIV is decreases gradually the immune system and leads to death as a direct result of one or more opportunistic infections. Opportunistic infection is an infection caused by immune deficiencies as a result of the HIV. Factors that influence the Opportunistic infection is predisposition and clinical manifestation. Predisposition is the internal factors that exist in individuals, families, communities that make easier individuals to behave. Clinical manifestations is presence indication of a disease that is perceived as complaints from patients and has been examined by a doctor or clinic. Predisposition include of age, level of education, work and marital status. And clinical manifestation include of CD4 and clinical stage.

III. METHODOLOGY

A. Source of Data

The data used in this research is secondary data on the medical records of HIV / AIDS patients in one hospital. The number is 91 patients HIV/AIDS. By using several variables as follows:

1. Exogenous Variables
   a Predisposition : age, level of education, work and marital status,
   b. Clinical manifestation : CD4 and clinical stage
2. Endogenous Variables: Opportunistic infection
3. Confounding variables: Adherence therapy ARV

B. Method of Analysis

Based on the research objectives, analysis methods used in this study is

1. Select confounding variables
2. Determine the propensity score approach to SEM
   a. Develop the conceptual model based on the theory
   b. Construct the path diagram
   c. Convert the path diagram into an equation system
   d. Estimate the parameters of model included
   e. Get the path coefficient value
   f. Determine the e propensity score value
3. Divide sample into Q strata based on propensity score and calculate the marginal mean weight

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4. Examine the balancing of the covariates
5. Determine percentage bias reduction (PBR)

IV. ANALYSIS AND DISCUSION

A. Select confounding variable

Confounding variable according to the epidemiology is a situation where the size of the effect of distorted risk factors because of the correlation between exposure and other factors that influence the results [11]. The actual relationship between exposure factors and impact /disease factors are disappear or covered by other factors, so the influence of confounding factors can increase or decrease the actual relationship. Chi-square test was used to examine the relationship among variables, the following hypotheses [12]:

H_0: There is no significant relationship among variables

H_1: There is a significant relationship among variables

Significance level: $\alpha = 5\%$

Critical region: reject H_0 if $\chi^2 > \chi^2_{1-\alpha}; df = (i-1)(j-1)$ or p-value < α

TABLE 1. RELATIONSHIP BETWEEN ADHERENCE WITH PREDISPOSISI & CLINICAL MANIFESTASI

Variable	χ^2	***P-value***	**Decision**
ADH*Predisposition	5.315	0,021	reject H_0
ADH*Clinical manifestation	7.662	0,006	reject H_0

Based on the Table 1, can be seen that the adherence has a relationship with the predisposition and clinical manifestation. Therefore variable adherence is confounding variables. Diagram path after the formed variable interactions from compliance with adherence ARV the relationship among predisposition variables and adherence ARV the relationship among clinical manifestations of the opportunistic infection can be seen at figure 2.

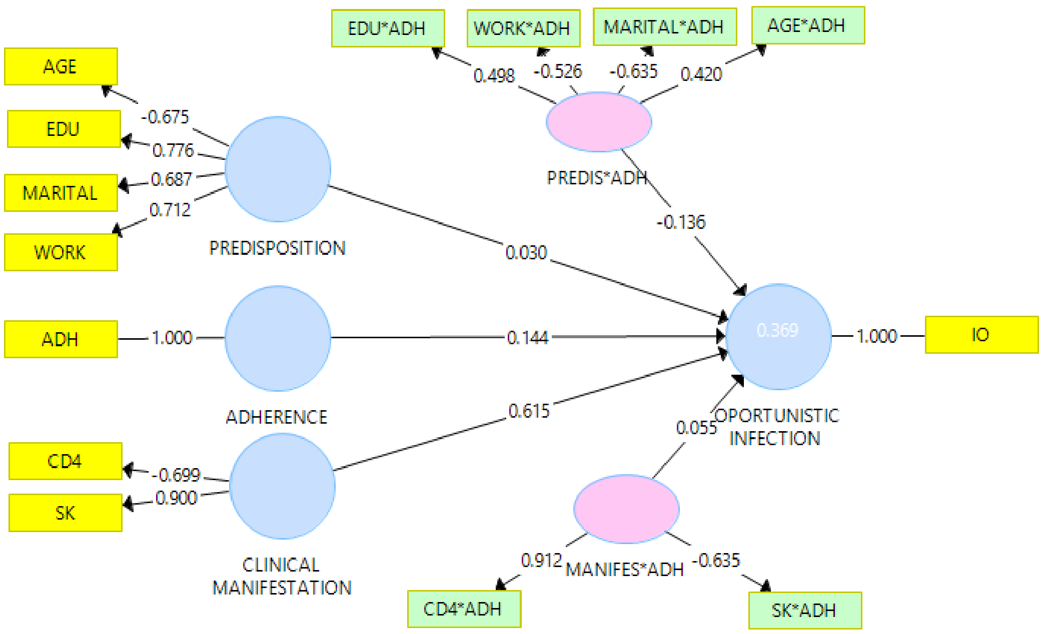

FIGURE 2. DIAGRAM PATH VARIABLE CONFOUNDING

Based on the figure 2 diagram path after putting confounding variables, the structural equation model is:

Opportunistic Infection = 0.030 predisposition + 0.144 clinical manifestation + 0.615 adherence - 0.136 (Predis*adh) + 0.050 (manifes*adh)

B. Calculating of MMWS

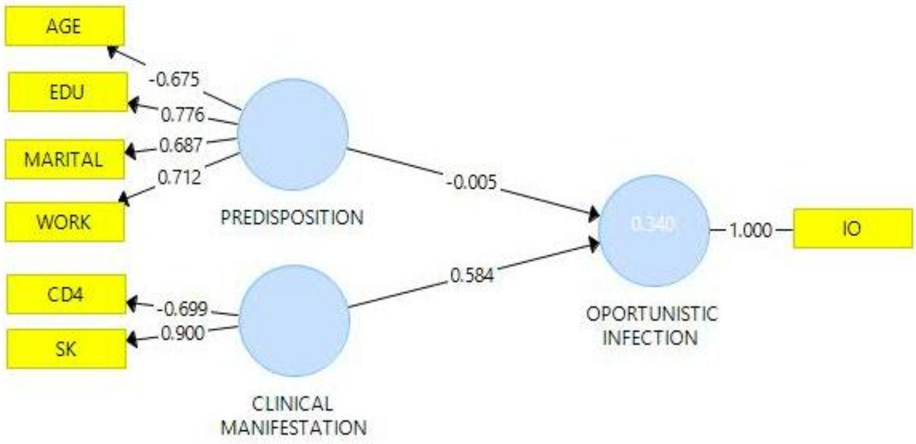

FIGURE 3 : LOADING FACTOR OF EACH LATEN VARIABLE

Based on the figure 2, can be seen that the loading factor of each indicator more than 0.5. Hence can be concluded that a valid indicator to measure the construct predisposition and clinical manifestation. Then calculate the propensity score using SEM-PLS. The propensity score for all respondents are used to divide respondents into five strata. Furthermore, calculating the marginal mean weight to tread groups and untreated groups uses the equation recommended as follows [9].

$$\frac{n_s \times \Pr(Z = z)}{n_{z=z,s}} \tag{3}$$

Where, n_s is the total number of individuals in stratum s, $\Pr(Z = z)$ is assignment probability to treatment groups z. $n_{z=z,s}$ is the total number of individuals in stratum s which is the actual treatment assignment for z.

TABEL 2. THE CALCULATION OF THE MMWS

Stratum	**Sample**	**Unweighted sample**		**MMWS**		**Weighted sample**	
		Treated	Untreated	z	z'	z	z'
1	19	10	9	0.626	1.42	6	13
2	18	6	12	0.989	1.01	6	12
3	18	4	14	1.484	0.86	6	12
4	18	8	10	0.742	1.21	6	12
5	18	2	16	2.967	0.75	6	12

After calculate MMWS can increase the homogeneity of propensity score between the treatment group and the control group in each stratum. The homogeneity or balance covariates in each stratum using the t-statistic for numerical variables. Insignificant T-values indicate adequate MMWS. The results of cheking balance covariate of each stratum are presented in Table 3.

TABLE 3: *T*-TEST FOR CHECKING BALANCE

Stratum	**Predisposition**			**Clinical Manifestation**		
	***T*-value**	$T_{(df,\alpha)}$	**Decision**	***T*-value**	$T_{(df,\alpha)}$	**Decision**
1	0.390	6.314	Not reject H_0	0.911	1.812	Not reject H_0

2	0.298	1.655	Not reject H_0	0.495	1.652	Not reject H_0
3	1.196	6.314	Not reject H_0	0.367	1.703	Not reject H_0
4	1.582	6.314	Not reject H_0	0.747	1.648	Not reject H_0
5	1.116	1.687	Not reject H_0	1.216	1.653	Not reject H_0

Based Table 3 shows that after MMWS there is no difference between the treatment group and control. Furthermore, compute a percentage bias reduction (PBR) on the covariate is another criterion to assess the effectiv of MMWS.

$$PBR = 100 \times \frac{\left(\overline{x}_t - \overline{x}_c\right)_{beforeMMWS} - \left(\overline{x}_t - \overline{x}_c\right)_{AfterMMWS}}{\left(\overline{x}_t - \overline{x}_c\right)_{AfterMMWS}} \quad (4)$$

Based on calculate of percentage bias reduction (PBR) obtained 93.5%. So that MMWS able to reduction bias 93.5%. It this sufficient of the bias reduction based on the examples in Cochran and Rubin PBR value of 80% or higher is satisfactory.

V. CONCLUSION

SEM-PLS can see that loading factor for each indicator on each latent variable is greater than 0.5, so that the indicators (age, level of education, work and marital status) were able to explain the predisposition variable and indicators (CD4, clinical stage) capable explain the clinical manifestation variable. Furthermore, score factor of each of the latent variables used to calculate a propensity score that will be used at this stage of Marginal mean through weighting stratification (MMWS) to reduce bias due to confounding variable. Marginal mean weighting through stratification (MMWS) method is a powerful because MMWS showed a reduction from the selection bias more than 93.5%.

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Regression Spline Truncated Curve in Nonparametric Regression

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Abstract**—**Nonparametric regression is used when regression curve is not known. Nonparametric regression curve is simply assumed to be smooth in the sense of space contained within a particular function. Data expected to find the shape of its estimation without being influenced by subjective factor of the researcher. Thus, the nonparametric regression approach has high flexibility. Nonparametric regression does not assume the shape of regression curve, regression curve is assumed to be contained within a particular function space. Infant deaths are deaths that occur in infants at an interval between time after birth until baby has not been exactly one year old. Magnitude which stated the possibility of babies die after birth until the age of one year per thousand live births is called Infant Mortality Rate (IMR). IMR data based on scatterplot with each predictor exhibits patterns that tend not follow a particular pattern (linear or a certain degree polynomial), so that the corresponding regression model approach is nonparametric spline regression model. Knot used is 1 knot, 2 knots and 3 knots and can be concluded that nonparametric regression model spline best produced is combination knot where significant variable are variable (X_1) The Percentage Of Aid Last Deliveries Performed By Non-Medical Assistance, (X_2) Marriage Percentages In Which Age of Women whom Married is Less Than 17 Years and (X_3) The Average Number Of Household Expenditure Per Capita Per Month.

Keywords: *nonparametrics, spline, knots, IMR*

I. INTRODUCTION

Regression modeling methods are divided into three, parametric regression, nonparametric regression and semiparametric regression. Semiparametric regression is used when one of the regression curve is not known, while others are known [1]. Nonparametric regression curve is only assumed to be smooth in the sense of space contained within a particular function. Data expected to find its shape of estimation, without being influenced by subjective factor of the researcher. Thus, the nonparametric regression approach has high flexibility [2]. Nonparametric regression does not assume the shape of regression curve, regression curve is assumed to be contained within a particular function space e.g. Sobolev Space (Eubank, 1988). In reality, not all of data model can be predicted with parametric regression approach in the absence of complete information about the regression curve shape. In such circumstances, it can be used nonparametric regression approach [3]. Nonparametric regression with spline approach is a method often used. In this study, we will estimate spline regression to model the function of Infant Mortality Rate (IMR) in Indonesia.

Infant deaths are deaths that occur in infants at an interval between the time after birth until the baby has not been exactly one year old. Magnitude which stated the possibility of babies die after birth until the age of one year per thousand live births is called Infant Mortality Rate (IMR). Based on the Indonesian Demographic and Health Survey, the IMR in Indonesia reached 32/1000 infant live births, this number is quite high compared to the standard of the Millennium Development Goals (MDGs), 23/1000 for IMR. Indonesian government is expected to reduce the value of IMR through programs initiated or to identify and resolve the factors that significantly affect the high value of IMR. East Java Province in the same year has IMR up to 32.43 deaths per 1,000 live births. In 2009 the IMR number is decreased to 31.41, while in 2010 the IMR became 29.99 deaths per 1,000 live births. This fact shows that East Java has not been able to reach the target of MDG's [4]. Data IMR based on scatter diagram with each predictor reveal patterns that tend not follow a particular pattern (linear or a certain degree polynomial), so that the corresponding regression model approach is nonparametric regression model. The characteristics of data IMR pattern is partially not have pattern so that the spline method is used to model the data pattern.

II. METHOD

A. Regression Analysis

Regression analysis is statistical analysis used to model the pattern of relationship between predictor variables and response variable. Parametric regression approach is used if the regression curve shapes are known. If relation of pattern data form linear pattern then used parametric linear regression approach. If relation of pattern data form a squares pattern then used quadratic regression approach, and others [2]. Relation of shape pattern can be identified based on past information or scatterplot of data [3].

B. Nonparametric Regression

Non-parametric regression is regression method approach in which the curve of regression function is unknown. The curve function assumed to be contained within a particular function space [2]. Nonparametric regression model is given by the following equation.

$$y_i = f(x_i) + \varepsilon_i, i = 1,2, \dots , n$$

with y_i is the response, variable, x_i is the predictor variables, $f(x_i)$ is the regression function, where the shape of the curve is unknown and ε_i are normally distributed random error, with zero mean and variance σ^2.

C. Nonparametric Spline Regression

Spline in nonparametric regression has high flexibility and the ability to estimate the behavior of data which tend to be different at different intervals [2]. This ability to estimate the behavior of data is indicated by the truncated function (pieces) which are attached to the estimator and pieces of so-called point knots. Knot point is the point of fusion joint that show changes in behavior patterns functions of different interval. Spline is one kind of piecewise polynomial, polynomial which has segmented nature. The segmented nature provides more flexibility than ordinary polynomials, thus allowing it to adapt more effectively to the local characteristics of a function or data. Spline function of degree p is any function that can generally presented in the following forms:

$$f(x_i) = \sum_{j=0}^{p} \beta_j x_i^j + \sum_{j=1}^{k} \beta_{j+p} (x_i - k_j)_+^p$$

with β_j are real constants, and

$$(x_i - k_j)_+^p = \begin{matrix} (x_i - k_j)^p & ; x \geq k_j \\ 0 & ; x < k_j \end{matrix}$$

If p = 1, 2, and 3 respectively spline linear, quadratic and cubic spline spline and k_j is point knots.

Assuming an error ε_i independent normal distribution with average zero and variance σ^2, then y_i in regression models also normally distributed with an average $f(x_i)$ and variance σ^2. Estimates for the parameter β by using the least squares method, namely by minimizing the sum of squared errors is as follows,

$$\sum_{i=1}^{n} \varepsilon_i^2 = \sum_{i=1}^{n} \left(y_j - f(x_i)\right)^2$$

β estimator can be obtained from minimizing

$$Q(\beta) = (y - X\beta)^T (y - X\beta)$$

To obtain the best spline regression estimator, it is necessary to select knots optimal point. Method used is Generalized Cross Validation (GCV). GCV functions as follows:

$$GCV(K_1, K_2, \dots , K_r) = \frac{MSE(K_1, K_2, \dots , K_r)}{\left(n^{-1} tr\left[I - A\left((K_1, K_2, \dots , K_r)\right)\right]\right)^2}$$

Value $(K_1, K_2, \dots , K_r)$ is the point of knots, while the matrix $A(K_1, K_2, \dots , K_r)$ obtained from the equation $\hat{y} = A(K_1, K_2, \dots , K_r)\tilde{y}$ and $MSE(K_1, K_2, \dots , K_r) = n^{-1} \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$

III. PROCEDURES

This study uses secondary data from the Central Bureau of Statistics (BPS) in 2011. Observation unit in this study was 38 district/city in East Java in 2011. The variables used are Infant Mortality Rate (IMR), the percentage of aid last deliveries performed by non-medical assistance, marriage percentages in which age of women whom married is less than 17 years, the average number of household expenditure per capita per month, the percentage of infants aged 0-11 months were given breast milk, and the number of health facilities (hospitals and health centers). Step analysis are carried out as follows.

1. Creating a scatter plot between response variable with each predictor variable.
2. Modeling data using spline estimation with various knots (one knot, two knots and three knots).
3. Choosing the optimal knots point with GCV method
4. Establish the best models from the smallest GCV value.
5. Calculate the MSE and R^2 of data.

IV. RESULT AND DISCUSSION

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A. Characteristics of Infant Mortality and Factors Affecting

Data infant mortality rate and factors that influence described using mean, standard deviation, minimum and maximum values. Here are the characteristics of infant mortality data and factors that influence are presented in Table 1.

TABEL 1. CHARACTERISTICS OF INFANT MORTALITY AND FACTORS AFFECTING

Variable	**Mean**	**Standard Deviation**	**Minimal**	**Maximal**
Y	34,18	12,68	20,02	64,19
X_1	8,31	11,19	0,00	44,99
X_2	27,00	13,00	10,07	59,09
X_3	239322	105660	122240	558590
X_4	93,952	4,640	83,920	100,000
X_5	90,11	39,94	13,00	189,00

B. Scatterplot Data Infant Mortality and Factors Affecting

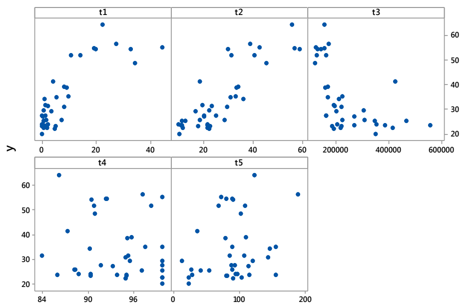

FIGURE 1. SCATTERPLOT DATA

Based on Figure 1, it shows that the relationship between the variables in infant mortality with each factor does not follow specific pattern because plot data is scattered randomly. Thus, the independent variable is nonparametric component.

C. Nonparametric Spline Truncated Regression Model

Nonparametric regression model, truncated spline, with a single point of knots in general are as follows.

$$y_i = \gamma_0 + \gamma_1 t_{i1} + \gamma_2 (t_{i1} - k_1)_+ + \gamma_3 t_{i2} + \gamma_4 (t_{i2} - k_1)_+ + \gamma_5 t_{i3} + \gamma_6 (t_{i3} - k_1)_+ + \gamma_7 t_{i4}$$
$$+ \gamma_8 (t_{i4} - k_1)_+ + \gamma_9 t_{i5} + \gamma_{10} (t_{i5} - k_1)_+ + \varepsilon_i$$

Here are iteration results of the best knot point value based on GCV minimum.

TABLE 2. SINGLE POINT OF KNOT

Knot X_1	**Knot X_2**	**Knot X_3**	**Knot X_4**	**Knot X_5**	**GCV**
0.92	11.07	131145.10	84.25	16.59	36.39
1.84	12.07	140050.20	84.58	20.18	36.66
2.75	13.07	148955.31	84.90	23.78	37.06
10.10	21.07	220196.12	87.53	52.51	37.50
11.02	22.07	229101.22	87.86	56.10	37.70

In Table 2, GCV smallest value obtained was 36.39. The value of knot point for variable X_1 is 0.92, variabel X_2 is 11.07, variable X_3 is 131145.10, variable X_4 is 84.25 and variable X_5 is 16.59.

Truncated spline nonparametric regression model with two point knots in general are as follows.

$$y_i = \gamma_0 + \gamma_1 t_{i1} + \gamma_2 (t_{i1} - k_1)_+ + \gamma_3 (t_{i1} - k_2)_+ + \gamma_4 t_{i2} + \gamma_5 (t_{i2} - k_1)_+ + \gamma_6 (t_{i2} - k_2)_+ + \gamma_7 t_{i3}$$
$$+ \gamma_8 (t_{i3} - k_1)_+ + \gamma_9 (t_{i3} - k_2)_+ + \gamma_{10} t_{i4} + \gamma_{11} (t_{i4} - k_1)_+ + \gamma_{12} (t_{i4} - k_2)_+ + \gamma_{13} t_{i5}$$
$$+ \gamma_{14} (t_{i5} - k_1)_+ + \gamma_{15} (t_{i5} - k_2)_+ + \varepsilon_i$$

Here are iterations results of two points based on the best knots GCV minimum.

TABLE 3. TWO POINT OF KNOT

X_1		X_2		X_3		X_4		X_5		**GCV**
K_1	K_2	K_1	K_2	K_1	K_2	K_1	K_2	K_1	K_2	
11,9	42,2	23,1	56,1	238006,3	531874,7	88,2	99,0	59,7	178,2	31,9
11,0	42,2	22,1	56,1	229101,2	531874,7	87,9	99,0	56,1	178,2	32,0
11,9	43,2	23,1	57,1	238006,3	540779,8	88,2	99,3	59,7	181,8	32,0
11,0	43,2	22,1	57,1	229101,2	540779,8	87,9	99,3	56,1	181,8	32,1
11,9	44,1	23,1	58,1	238006,3	549684,9	88,2	99,7	59,7	185,4	32,1

Based on Table 3, GCV smallest value obtained was 31.9. The value of knot point for variable X_1 are $k1$ amounted to 11,9 and k2 amounted to 42,2. Knots point value for variable X_2 are $k1$ amounted to 23.1 and k2 amounted to 56.1 $k2$. For variable X_3 are $k1$ amounted to 238006.3 and $k2$ amounted to 531874.7. For variable X_4 are $k1$ amounted to 88,2 and $k2$ amounted to 99.0, while for the variable X_5 are $k1$ amounted to 59.7 and $k2$ amounted to 178.2.

Nonparametric regression model with a three-point spline truncated knots in general are as follows..

$$y_i = \gamma_0 + \gamma_1 t_{i1} + \gamma_2 (t_{i1} - k_1)_+ + \gamma_3 (t_{i1} - k_2)_+ + \gamma_4 (t_{i1} - k_3)_+ + \gamma_5 t_{i2} + \gamma_6 (t_{i2} - k_1)_+$$
$$+ \gamma_7 (t_{i2} - k_2)_+ + \gamma_8 (t_{i2} - k_3)_+ + \gamma_9 t_{i3} + \gamma_{10} (t_{i3} - k_1)_+ + \gamma_{11} (t_{i3} - k_2)_+$$
$$+ \gamma_{12} (t_{i3} - k_3)_+ + \gamma_{13} t_{i4} + \gamma_{14} (t_{i4} - k_1)_+ + \gamma_{15} (t_{i4} - k_2)_+ + \gamma_{16} (t_{i4} - k_3)_+ + \gamma_{17} t_{i5}$$
$$+ \gamma_{18} (t_{i5} - k_1)_+ + \gamma_{19} (t_{i5} - k_2)_+ + \gamma_{20} (t_{i5} - k_3)_+ + \varepsilon_i$$

Here are the result of three-point iteration based on the best knots GCV value minimum.

TABLE 4. THREE POINT OF KNOT

		X_1	X_2	X_3	X_4	X_5	GCV
	K_1	0.92	11.07	131145.10	84.25	16.59	
1	K_2	11.94	23.08	238006.33	88.19	59.69	28.36858
	K_3	41.32	55.09	522969.59	98.69	174.63	
	K_1	0.92	11.07	131145.10	84.25	16.59	
2	K_2	11.94	23.08	238006.33	88.19	59.69	28.38476
	K_3	42.24	56.09	531874.69	99.02	178.22	
	K_1	0.92	11.07	131145.10	84.25	16.59	
3	K_2	11.94	23.08	238006.33	88.19	59.69	28.39802
	K_3	43.15	57.09	540779.80	99.34	181.82	
	K_1	0.92	11.07	131145.10	84.25	16.59	
4	K_2	11.94	23.08	238006.33	88.19	59.69	
	K_3	44.07	58.09	549684.90	99.67	185.41	28.40616
	K_1	0.92	11.07	131145.10	84.25	16.59	
5	K_2	22.04	34.08	335962.45	91.80	99.20	28.60887
	K_3	24.79	37.08	362677.76	92.78	109.98	

Based on Table 4, GCV smallest value obtained is 24.67.

D. Optimal Knot Point Selection

After getting knots value for each predictor variable, the next step is to compare GCV value of each model to choose which one is the best knots. Here are the smallest GCV value of each point knots results.

TABLE 5. SMALLES GCV VALUE FROM EACH MODELLING

Knot	**GCV**
1 Knot	36.4
2 Knots	31.9
3 Knots	28.4
Knot Combinations	27.3

Bold –Knot value which has smallest GCV

The smallest GCV value is modeling with knot combinations that is equal to 27,3.

E. Modelling Infant Mortality by Optimal Knot Point

The combination of knots optimum point is

$$\begin{aligned}\hat{y} = &-0.00003 + 0.1569x_{i1} + 0.1524(x_{i1} - 0.9182)_+ + 0.2183x_{i2} + 0.2178(x_{i2} - 11.07)_+ \\ &+0.00037x_{i3} - 0.000054(x_{i3} - 13145.1)_+ + 0.000024(x_{i3} - 238006.3)_+ \\ &-0.000062(x_{i3} - 522969.6)_+ - 0.14976x_{i4} - 0.1463(x_{i4} - 84.25)_+ \\ &-0.118x_{i5} + 0.2211(x_{i5} - 59.69)_+ + 0.0283(x_{i5} - 178.22)_+\end{aligned}$$

R^2 value of this model is 89.38 percent. This means that 10.62 percent of IMR are able to be explained by variable percentage of aid last deliveries performed by non-medical assistance, marriage percentages in which age of women whom married is less than 17 years, the average number of household expenditure per capita per month, the percentage of infants aged 0-11 months were given breast milk, and the number of health facilities in Spline Regression Model Truncated with combination knot of optimum knots.

F. Parameter Regression Examination

There are two test parameter estimation to be performed, simultaneously testing and individual testing. Here are the results of simultaneously testing by using F-statistic test.

TABLE 6. ANALYSIS OF VARIANCE

Variance Source	db	*Sum Square*	*Mean Square*	F	P-*value*
Regresi	13	5308.908	408.3775	16.20971	8.23152e-09
Error	24	604.6414	25.19339		
Total	37	5913.549			

F-test value is 16.21 and the F degree of freedom table value for v_1 amounted to 13 and v_2 amounted to 24. Thus, the value of F-test > F_{tabel} so it can be concluded that we rejected H_0 which mean there are at least one predictor variable which has significant impact on the model. Next step is doing individual testing to determine what variables that has significant impact. The results of individual tests are presented in Table 7.

TABLE 7. INDIVIDUAL TESTING PARAMETER RESULTS

Variable	Parameter	Estimator	*t*	P-*value*
Konstan	γ_0	-3.532E-05	-0.285	0.77833
X_1	γ_1	1.569E-01	2.398	0.024632
	γ_2	1.524E-01	2.335	0.028209
X_2	γ_3	2.183E-01	3.776	0.000926
	γ_4	2.178E-01	3.774	0.000931
X_3	γ_5	3.727E-04	3.363	0.002583
	γ_6	-5.437E-04	-3.712	0.001087
	γ_7	2.447E-04	3.809	0.000852
	γ_8	-6.184E-04	-2.534	0.018221
X_4	γ_9	-1.497E-01	-1.563	0.131213
	γ_{10}	-1.463E-01	-1.602	0.122276
X_5	γ_{11}	-1.118E-01	-1.122	0.273009
	γ_{12}	2.211E-01	1.778	0.088093
	γ_{13}	2.829E-02	1.418	0.168963

Individual parameter test results of 14 parameters which are contained in nonparametric spline regression model, 6 parameters are not significant because p-value is greater than α. The significant parameters are $\gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6, \gamma_7$ and γ_8.

G. Testing Residual Assumption

Residual assumptions that must be fulfilled to find the best model are assumption of identical residual, independent and normally distributed. Testing assumptions using identical residual test presented Glejser role is in the following Table

TABLE 7. GLEJSER TESTING RESULTS

Sumber Variasi	db	*Sum Square*	*Mean Square*	F	P-*value*
Regresi	13	47.904	3.685	0.514	0.894
Error	24	172.184	7.174		
Total	37	220.088			

P-value of Glejser testing residual is 0.894, the value is greater than the value of α of 0.05, so can be concluded that H_0 failed to reject it means that heteroskedastisity is not occur in the model so that identical residual assumption are met. Examination of independent residual assumption use ACF plot is presented in Figure 2 below.

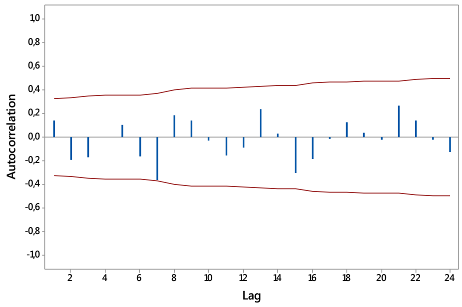

FIGURE 2. RESIDUAL ACF PLOT

Based on ACF plot for residual, there is no significant autocorrelation (ACF) values or out of the upper limit and lower limit. It can be concluded that the assumption of residuals independent are met and no autocorrelation between residuals. Here is residual normal distribution testing using Kolmogorov Smirnov test statistics that are presented in Figure 3.

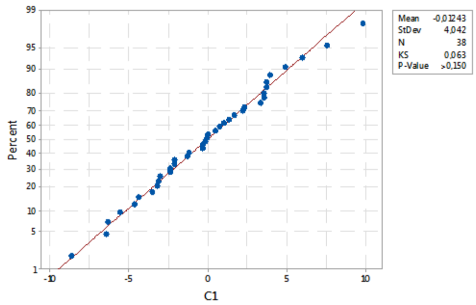

FIGURE 3. RESIDUAL NORMALITY PLOT

Based on normality plot model residual, obtained p-value is greater than 0.150 where the value is greater than the value of α which is equal to 0.05. Testing for normality using Kolmogorov Smirnov statistics with p-value > α can be concluded that H_0 failed to reject, which means residual has normal distribution. So, assumption of normal distribution are met. The test results for assumption of identical residual, independent, and normal distribution are met, then the model used is appropriate and can be done interpretation of the best model.

CONCLUSIONS

Based on modeling results of infant mortality rate in Indonesia using nonparametric regression splines can be concluded that truncated nonparametric spline regression model is the best produced knots with determination coefficient of 89.38 percent where significant variablea are variable (X_1) The Percentage Of Aid Last Deliveries Performed By Non-Medical Assistance, (X_2) Marriage Percentages In Which Age Of Women Whom Married Is Less Than 17 Years and (X_3) The Average Number Of Household Expenditure Per Capita Per Month.

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M – 19

Construction of Fuzzy System of Zero-Order Takagi-Sugeno-Kang Using Singular Value Decomposition Method and Its Application for Diagnosing Cervical Cancer

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Abstract—Cervical cancer is a deadly disease for women. But over the last 30 years, the cervical cancer death rate has gone down by more than 50%. The main reason for this change was the increased use of the Pap test. Therefore, it is very important to perform early detection and diagnosis to determine the possibility of cervical cancer. Fuzzy System can be used for diagnosis of cervical cancer. In this paper, the diagnosis of cervical cancer stage is based on colcoscopic images that have been extracted to 21 properties of the image. Those properties are selected that yield four image extractions those are difference entropy, mean, correlation and sumaverage. These four extractions are used as input variables to the fuzzy system built using Gauss curve representation. The output variables of this system are normal, stage 1, stage 2, stage 3 and stage 4. Fuzzy rules of zero-order Takagi-Sugeno-Kang fuzzy system are developed by singular value decomposition method. This method is used to determine the parameters of consequent of rules. In this paper, we use 80 training data and 10 testing data. The 80 training data yield 80 fuzzy rules. Then, the method of weight average is applied to defuzzification process. The results are that the accuracy, sensitivity, and specification of the fuzzy system are 83,8%; 100%; and 84,6%, respectively. While for test data, the accuracy, sensitivity, and specification of the fuzzy system are 70%; 100%; and 50%, respectively. Fuzzy system that has been formed is implemented with a Graphical User Interface (GUI).

Keywords: *cervical cancer, zero order Takagi-Sugeno-Kang, fuzzy system, singular value decomposition*

I. INTRODUCTION

Cervix is a part of the female reproductive system. Cervical cancer affects the cervix inside the pelvis. The disease is caused by HPV (Human Papilloma Virus). Cervical cancer is a deadly disease for women in both developed and developing countries. According to [1], the mortality rate of cervical cancer has dropped by more than 50% for the last 30 years. The main reason for this change is an increase in the use of Pap smear tests. Which serve as early detection. Therefore, early detection of cervical cancer need to be done in order to be given the proper treatment or medication. That reason makes many research on the early detection of cervical cancer has been conducted.

Reference [2] classified cervical cancer with a combination of fuzzy model and stepwise regression. Inputs used are extracted colposcopy images from various stages of cervical cancer which generates 21 image properties. Furthermore, twenty-one properties were selected using stepwise regression to obtain a more dominant trait for input on fuzzy model. The process of fuzzy inference model using Mamdani method. Later model is used to predict whether a person is diagnosed normal, stage 1, stage 2, stage 3, or stage 4 of cervical cancer. The accuracy of the model reached 95% on 90% of the training data and testing data.

Researchers are continually improve the diagnosis of cervical cancer by a variety of methods. Fuzzy logic is one of the methods used to perform the diagnosis of cervical cancer. One of the method of fuzzy inference in fuzzy model is a zero-order Takagi-Sugeno-Kang (TSK) method. Zero order TSK method has an easier calculations. Based on [2], the authors use diagnosis of cervical cancer with the zero-order TSK fuzzy inference process. Then, singular value decomposition is used to determine of the consequent of the rule of the zero order TSK.

II. RESEARCH METHOD

The data used in this study are 90 colposcopy extraction results of secondary data obtained from research by [2]. Ninety colposcopy data used in this study are divided into two separate data, those are 80 training data and 10 testing data. Step-by-step analysis of the data is presented in Figure 1.

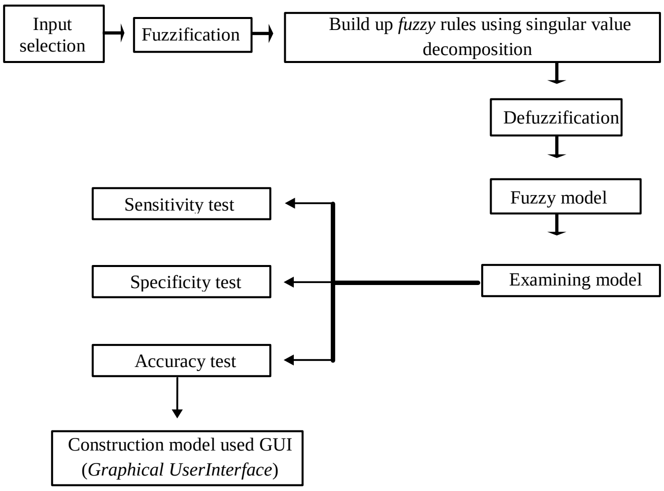

FIGURE 1. STEP STUDY CHART

After the built fuzzy system has good accuracy, the next step is to construct of interface for the fuzzy model use Graphical User Interface (GUI) matlab so that the display system will be more attractive. The basic design GUI (Graphical User Interface) for cervical cancer shown by Figure 2.

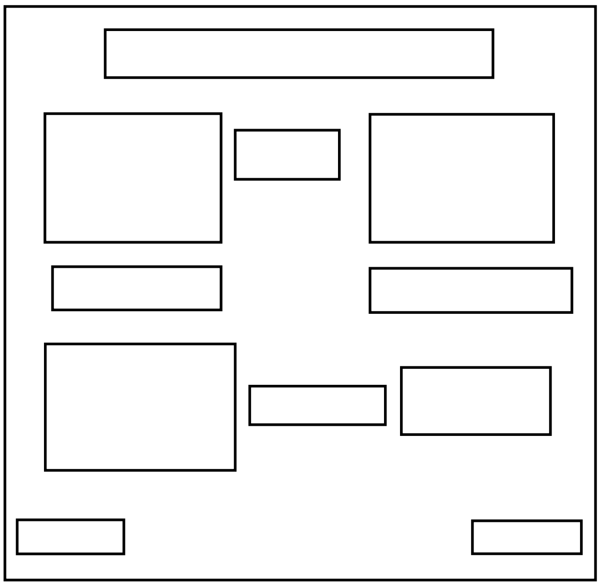

FIGURE 2. PRELIMINARY DRAFT GUI DISPLAY

III. DISCUSSION

Cervical colposcopy image extraction process produces 21 nature pictures. Furthermore, the nature of the twenty-first selected using stepwise regression method, resulting in a 4 properties significantly to the diagnosis of cervical cancer. Four properties were obtained difference entropy, correlation, mean, sum average. Extraction image process and selecting properties significantly to the diagnosis has been made by [2].

A. Fuzzification

Each input is defined in the fuzzy set based on the universal set. The set can be determined with a universal approach of the minimum value and the approach of the maximum value of the data of the extracted image. The set of four input is universal for difference entropy (D) = [0,19 0,62], correlation (C) = [0,86 0,99], mean (M) = [52 185] and sum average (S) = [4,3 12,6]. Furthermore, each input fuzzy set represented in the membership function Gauss curve. Gauss curve membership functions in Matlab as follows:

$$f(x,\theta,c) = e^{\frac{-(x-c)^2}{2\theta^2}} \tag{1}$$

Each input is divided into 9 fuzzy sets in the same range, for the entropy difference is D1, D2, D3, D4, D5, D6, D7, D8, D9. Gauss curve representation for entropy difference is shown in Figure 3.

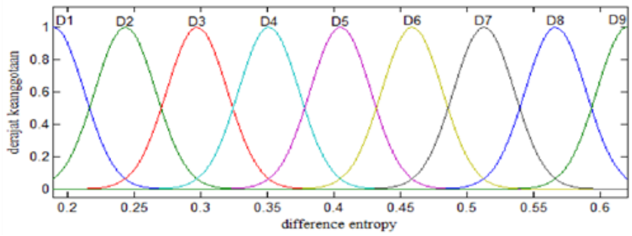

FIGURE 3. MEMBERSHIP FUNCTION OF DIFFERENCE ENTROPY

Furthermore, the output is defined in the nearest rounding constant number which are divided into five numbers, 0, 1, 2, 3, and 4. Numbers 0 is a normal phase, 1 is a stage 1, 2 is a stage 2, 3 is a stage 3 and 4 is the phase of a stadium stage 4 cervical cancer.

B. Constructing Fuzzy Rules

Each value extraction results on the training data used as input sought the largest membership value in fuzzy set to build the fuzzy rules. The following is the result of the first training data and grouping in the fuzzy set.

TABLE 1. RESULTS FIRST DATA EXTRACTION AND CLASSIFICATION OF FUZZY INPUT IN SET

Data	Ekstraction results	Fuzzy Set
Difference Entropy	0.36838	D_4
Correlation	0.94068	C_6
Mean	171.0023	M_8
Sum Average	11.6581	S_8
Diagnosis		Stage 1

Thus the rules established for training data number 1 are as follows:
Rule (1) If difference entropy is D_4 and correlation is C_6 and mean is M_8 and sum average is S_8 Then stage 1.
All of training data calculation, obtained 74 rules. Inference system used the zero order TSK method. In general form of zero order TSK [3] are as follows:

$$\text{If } (x_1 is\ A_1)\ o\ (x_2 is\ A_2)\ o \ldots o\ (x_i is\ A_i) \text{ Then } y = b_i \tag{2}$$

where b is a constant. The fuzzy rules for fuzzy rules zero order system of TSK become
Rule (1) If difference entropy is D_4 and correlation is C_6 and mean is M_8 and sum average is S_8 Then $y_1 = b_1$.

C. Defuzzification

The process of defuzzification in this resarch using the method of weight average with formula [4]:

$$y = \frac{\sum_{i=1}^{L} y_i(\mu_{i1}(x_1)\mu_{i2}(x_2)...\mu_{in}(x_n))}{\sum_{i=1}^{L} \mu_{i1}(x_1)\mu_{i2}(x_2)...\mu_{in}(x_n)} \tag{3}$$

The (3) equation can be stated as

$$y = \sum_{i=1}^{L} w_i y_i \tag{4}$$

where $w_i = \frac{\mu_{i1}(x_1)\mu_{i2}(x_2)...\mu_{in}(x_n)}{\sum_{i=1}^{L} \mu_{i1}(x_1)\mu_{i2}(x_2)...\mu_{in}(x_n)}$. Next, based on [5] set up a model which minimizes the objective function J with

$$J = \sum_{k=1}^{N} \big(d(i) - y(i)\big)^2 = (d - Xb)^T(d - Xb) \tag{5}$$

where $d(i)$ is the real output for all data pairs i, $y(i)$ is the zero order TSK model output for all data pairs i. Then $d = [d(1)d(2) \dots d(N)]^T$, X is the matrix with size $N \times L$, where N is the number of data and L is the amount of formed fuzzy rules and $b = [b_{10}\ b_{11}\ \dots\ b_{1n}\ \dots\ b_{L0}\ b_{L1}\ \dots\ b_{Ln}]^T$ is the matrix with size $L \times 1$. The equation (5) can be achieved a minimum if $d - Xb = 0$ or $d = Xb$ with

$$X = \begin{bmatrix} w_1(1) & w_2(1) & \cdots & w_{74}(1) \\ w_1(2) & w_2(2) & \cdots & w_{74}(2) \\ \vdots & \vdots & \vdots & \vdots \\ w_1(80) & w_2(80) & \cdots & w_{74}(80) \end{bmatrix} = \begin{bmatrix} 0.9256 & 0.0256 & \dots & 0.0000 \\ 0.0006 & 0.9994 & \dots & 0.0000 \\ \vdots & \vdots & \vdots & \vdots \\ 0.0000 & 0.0000 & \dots & 0.0000 \end{bmatrix}$$

Then, the solution of $d = Xb$ can be solved using sigular value decomposition. The singular value decomposition of X [6] is $X = USV^T$, where U and V are unitary matrix and S is matrix $m \times n$ which all entries on the diagonal is a singular entri value where zero beyond the diagonal. The parameter *b* can be determined with formula [7] :

$$\hat{b} = \sum_{i=1}^{r} \sigma_i^{-1} < d, u_i > v_i = \sum_{i=i}^{r} \frac{u_i^T d}{\sigma_i} v_i \tag{6}$$

where r is count of non zero singular value, $U = [u_1, \dots, u_N]$, dan $V = [v_1, \dots, v_{(n+1)L}]$. Based on the equation (6) will be obtained constants $b = [1\ 1\ \dots\ 0]^T$.

Then k constant substitutable in 74 rules and gained rules for the training data number -1:

Rule (1) If *difference entropy* is D_4 and *correlation* is C_6 and *mean* is M_8 and *sum average* is S_8 Then $y_1 = 1$.

Further for the process of *defuzzification* can be calculated using equation (3). Once obtain the value of defuzzification, can be done a testing system to get accuracy rate, sensitivity rate, and specification rate. The formula for the accuracy level [8]:

$$accuracy = \frac{the\ number\ of\ the\ correct\ data}{the\ amount\ of\ entirely\ data} \times 100\% \tag{7}$$

$$sensitivity = \frac{TP}{TP+FN} \times 100\% \tag{8}$$

$$specification\ \frac{TN}{TN+FP} \times 100\% \tag{9}$$

Result defuzzification of training data is shown in Table 2.

TABLE 2. RESULT DEFUZZIFICATION OF TRAINING DATA

No.	y	Actual Stage	Predicted Stage	Performance measure
1	1	Stage 1	Stage 1	TP
2	1	Stage 1	Stage 1	TP
3	1	Stage 1	Stage 1	TP
4	1	Stage 1	Stage 1	TP
⋮				
80	0	Normal	Normal	TN

D. Result

Based on the *defuzzification* process done toward the train data achieved the classification result of cervical cancer. Thus can be calculated to examin the accuracy level from the training data which are the accuracy, sensitivity, and specification are 83,8%; 100%; and 84,6%, respectively. However in testing data, the level of accuracy is 70%, sensitivity is 100%, and the specificity is 50%.

Model diagnosis of cervical cancer are built with fuzzy model that has been tested, then construct a fuzzy model with a GUI to make it more attractive and easier for users. The final design model of diagnosis of cervical cancer stage with the GUI shown in Figure 4.

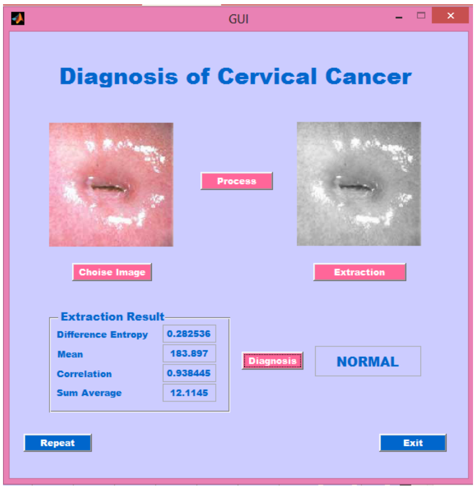

FIGURE 4. GUI DISPLAY RESULT OF NORMAL CERVIK DATA

IV. CONCLUSION

Ninety of data extraction of colposcopy images are divided into 80 data and 10 data testing training. Input on fuzzy model built using Gauss curve representation. Each input is divided into 9 fuzzy sets. Inference system used zero-order TSK method. Determination of the constants in the consequent of the rule that is built using singular value decomposition. Defuzzification process on the model using the method of weight average. If-Then fuzzy rules formed from the training data and obtained 74 rules. Output models which are a normal cervical cancer diagnosis, stage 1, stage 2, stage 3 and stage 4.

After a fuzzy model is established, the model accuracy for 80 training data accuracy, sensitivity and specificity was 83.8%; 100%; and 84.6%. Then, for the 10 data defuzzification results of testing showed levels of accuracy, sensitivity, and the specificity of 70%, 100% and 50%. Thus, the fuzzy model which has been built well enough represent a diagnosis.

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M – 20

Construction of Fuzzy Rules of Zero Order Takagi-Sugeno-Kang Fuzzy System Using Generalized Matrix Inverse Method and Its Application for Diagnosing Breast Cancer

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Abstract**—**Breast cancer is one of the most cancerous in Indonesia that the mortality rate is quite high. To date, the primary causes of breast cancer are still unknown. Therefore, early detection and diagnosis are needed to determine the possibility of breast cancer. One way to detect this cancer is with mammogram image. The aims of this study is to explain steps in applicating fuzzy system for breast cancer diagnosis using mammogram image and implement the result with GUI (Graphical User Interface). Another aims of this study is to compare the result with previous research. This study using 120 mammogram images that divided into 96 training data and 24 testing data. The fuzzy system used is zero order Takagi-Sugeno-Kang with 10 input variables and 3 output variables. To optimize the result, generalized matrix inverse method is used in building fuzzy rules and weight average method for defuzzification process. The accuracy, sensitivity, and specification of the zero order Takagi-Sugeno-Kang fuzzy system are 100% for training data. For testing data, the accuracy, sensitivity, and specification of the system are 50%, 77.77%, 66.67%, respectively. Whereas the accuracy of the Mamdani fuzzy system reached 96.875% and 100% for sensitivity, and specification in training data. In the testing data, the Mamdani fuzzy system reached 91.67%, 93.75%, and 87.5% in accuracy, sensitivity, and specification respectively. Based on these result, it can be concluded that the zero order Takagi-Sugeno-Kang fuzzy system is better than the Mamdani fuzzy system in training data, but need much improvement for testing data.

Keywords:*breast cancer diagnosis,mammogram image, fuzzy system, GUI*

I. INTRODUCTION

Breast cancer is a disease which the cells (tissue) of breast are grown and spread uncontrollably. The disease occurs almost entirely in women, but men can get it, too [1]. The breast cancer is one of malignant tumors which have been common to be found, WHO (World Health Organization) numerated breast cancer is the number one killer that threaten women's health [2]. According to 2012 data of GLOBOCAN (IARC) found that breast cancer is cancer disease with percentage of recent cases (controlled by age) the highest is 43.3% and mortality percentage (controlled by age) caused by breast cancer is 12.9% [3].

To date, the primary causes of breast cancer are still unknown. Even the symptom and the growth itself are hard to detect. Symptoms usually only discovered after the stage of the cancer develops further, because usually it does not cause any complaints in the early stages. Patients feel well, they do not feel any pains, and does not interfere to the activity. This condition causes many sufferers seek treatment in a state of advanced stage of cancer. This situation can complicate the healing process even increase the risk of death for patients. It will be much easier to do treatment when breast cancer can be found earlier [1].

Perceiving the importance of early detection and diagnosis of breast cancer makes many researchers conduct research in the diagnosis of breast cancer. Gerald Schaefer *et al* conduct research that aims to diagnose breast cancer using fuzzy classification method based on data calorimetry [4]. Hossein Ghayoumi Zadeh *et al* conduct research to detect breast cancer by combining breast thermography with Complementary Learning Fuzzy Neural Network (CLFNN) methods and built with image processing [5].

Shleeg and Ellabib diagnosed breast cancer using the method of Mamdani Fuzzy Inference System. They used the nine rules compared to Sugeno Fuzzy Inference System method [6]. In the same year Ali and Ayturk conducted research that aims to diagnose breast cancer using neuro-fuzzy classification method called NEFCLASS [7]. Research conducted by [8] to diagnose breast cancer with point operation using image mammogram data and implemented with a Graphical User Interface (GUI). In this study, the fuzzy inference process carried out by the mamdani method.

Based on the description above, it can be seen that the current research on the diagnosis of breast cancer has been conducted by researchers with a variety of methods. One widely used method associated with the diagnosis of breast cancer is fuzzy logic. Fuzzy logic is an appropriate way to map an input space into an output space. Fuzzy Logic will deliver value to an uncertainty as well, sufficient, and close [9].

Basically, there are a fuzzy system that can be used as a method in diagnosing breast cancer. For example, a diagnosis of breast cancer using mamdani fuzzy system that previously had been performed by [8]. In addition to the fuzzy system mamdani, other methods that may be used is zero-order Sugeno fuzzy system. Therefore, to compare between the two fuzzy system is then carried out further research into the diagnosis of breast cancer with the zero-order Sugeno fuzzy system.

In the establishment of zero-order Sugeno fuzzy systems there is the possibility that the rules were formed less than the consequent parameter estimated. Based on the rules and the consequent parameters can form a non-invertible matrix. Matrix non-invertible is hard to solve using the usual inverse so other methods are needed to solve them. The method that can be used is the inverse matrix of generalized or often referred to as pseudo-inverse. This method is general and can be used to find the inverse of any type of matrix including a non-invertible matrix. Based on the description above, underlie the author to conduct research on zero-order Sugeno fuzzy system in the diagnosis of breast cancer with generalized matrix inverse method for determining parameters of the consequent of fuzzy rules.

II. Research Method

The data used in this study were 120 mammograms a secondary data extraction results obtained from the image database Mammographic Image Analysis Society (MIAS) through the website http://peipa.essex.ac.uk/pix/mias. The data have previously been used by [8]. Based on the data of 120 mammograms were used in this study were divided into two, namely 96 training data and 24 testing data. Step-by-step analysis of the data presented in Figure 1.

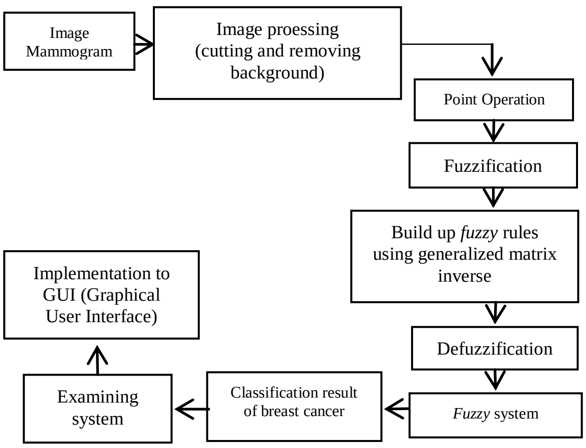

FIGURE 1. Step Study Chart

After the built fuzzy system has good accuracy, the next step is to create the look of the system with a GUI (Graphical User Interface) so that the display system will be more attractive. The initial design GUI (Graphical User Interface) for breast cancer shown by Figure 2.

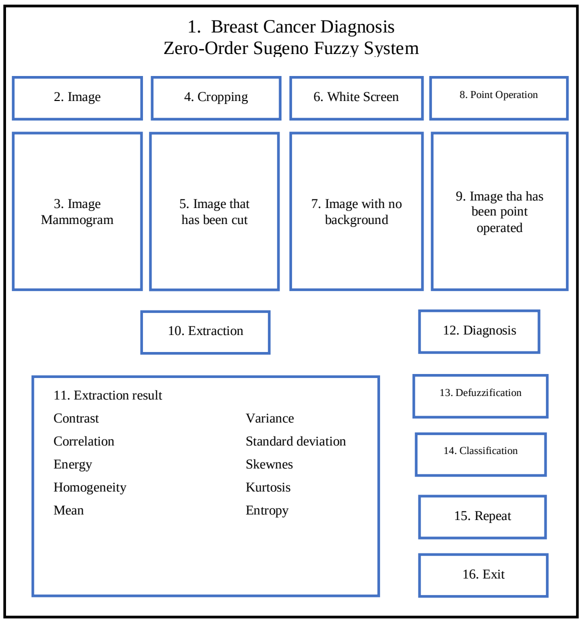

FIGURE 2. PRELIMINARY DRAFT GUI DISPLAY

III. DISCUSSION

The data used in this study is the mammogram image data that has previously been done image processing includes cutting, elimination of background and image enhancement with point operation. Image data that has been operated on point then extracted image so as to obtain 10 feature extractions, ie contrast, correlation, energy, homogeneity, mean, variance, standard deviation, skewnes, kurtosis, and entropy. Ten feature extractions are used as input variables. While the output variables used in this study was 3, which normally, benign and malignant. Image processing to obtain the extracted image has been done by [8].

A. Fuzzification

The next stage identifies the set of rules of input and output. To input a set of rules drawn from the minimum value and a maximum value of data from each extraction. The set of rules for each input that contrast = [0.134 0.235], correlation = [0.955 0.989], energy = [0.123 0.639], homogeneity = [0.939 0.979], mean [127.6 234], variance = [1973 7827], standard deviation = [44.42 88.47], skewnes = [-3.121 0.71], kurtosis = [1.36 13.13], entropy = [2.995 7.394]. While the output set of rules is in the interval [1 3]. One for normal, 2 for the benign, and 3 for malignant. Then define a fuzzy set for each input variable with 9 fuzzy set and is represented by gauss curve. Gauss curve representation for variable contrast is shown in Figure 3.

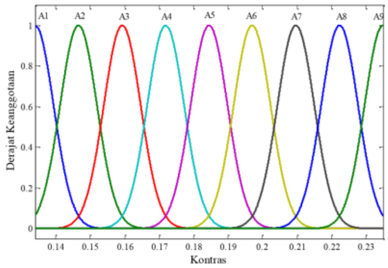

FIGURE 3. REPRESENTATION OF A SET OF FUZZY VARIABLE CONTRAST

B. Constructing Fuzzy Rules

Each value of the extracted image sought of the degree membership to the largest degree of membership then used to build the rules. The value of greatest degree of membership has been obtained from the respective image extraction feature are grouped in each variable fuzzy set membership degree input. The following is the result of the first training data and groupings in the fuzzy set.

TABEL 1. RESULT DATA EXTRACTION AND CLASSIFICATION 1 OF FUZZY INPUT IN SET

Image feature	Extraction result	Degree of membership	*Fuzzy* set
Contrast (x_1)	0,17765	0,562596	A_4
Correlation (x_2)	0,97352	0,701475	B_5
Energy (x_3)	0,26932	0,818787	C_3
Homogeneity (x_4)	0,96044	0,794505	D_5
Mean (x_5)	202,629	0,636253	E_7
Variance (x_6)	4336,078	0,86388	F_4
Standard deviation(x_7)	65,8489	0,968546	G_5
Skewnes (x_8)	-1,2388	0,977081	H_5
Kurtosis (x_9)	3,7231	0,650041	I_3
Entropy (x_{10})	5,5838	0,790291	J_6
Diagnosis			Normal

Thus the rules established for training data number 1 are as follows:

[Rule 1] If contrast is A_4 and correlation is B_5 and energy is C_3 and homogeneity is D_5 and mean is E_7 and variance is $F_4$and standard deviation is G_5 and skeunes is H_5 and kurtosis is I_3 and entropy is J_6 then the diagnosis is normal.

Using the same way to calculate and classify for another 95 data extraction result so that based on 96 training data which are used to construct system can be formed 96 fuzzy rules. This rule has been formed by [8]. Once obtained fuzzy ruels the next step is evaluating those rules in fuzzy rules of zero order Sugeno.

The form of fuzzy rules zero order of Sugeno is:

$$IF\ (x_1\ is\ A_{i1}\ ) \circ \ldots \circ (x_n\ is\ A_{in}\ )\ THEN\ y = k \quad (1)$$

Where k is a constant. The fuzzy rules for fuzzy rules zero order system of sugeno become

[Rule 1] If the contrast is A_4 and correlation is B_5 and energy is C_3 and homogeneity is D_5 and mean is E_7 and variance is F_4 and standard deviation is G_5 and skewnes is H_5 and kurtosis is I_3 and entropy is J_6 then $y_1 = k_1$.

[Rule 2] If the contrast is A_4 and correlation is B_5 and energy is C_3 and homogeneity is D_5 and mean is E_7 and variance is $F_4$and standard deviation is G_4 and skewnes is H_5 and kurtosis is I_3 and entropy is J_6 then $y_2 = k_2$.

⋮

[Rule 96] If the contrast is A_5 and correlation is B_6 and energy is C_2 homogeneity is D_5 d and mean is E_2 and variance is F_5 and variance is G_6 and skewnes is H_8 and kurtosis is I_2 and entropy is J_7 then $y_{96} = k_{96}$. When $k_1, k_2, \ldots, k_{96}$ are real constants which are going to be estimated. The process of determining k value using the method of generalized matrix inverse.

C. Defuzzification

The process of defuzzification in this resarch using the method of weight average with formula [10]:

$$y = \frac{\sum_{i=1}^{L} y_i(\mu_{i1}(x_1)\mu_{i2}(x_2)\ldots\mu_{in}(x_n))}{\sum_{i=1}^{L}\mu_{i1}(x_1)\mu_{i2}(x_2)\ldots\mu_{in}(x_n)} = \frac{\sum_{i=1}^{L} k_i(\mu_{i1}(x_1)\mu_{i2}(x_2)\ldots\mu_{in}(x_n))}{\sum_{i=1}^{L}\mu_{i1}(x_1)\mu_{i2}(x_2)\ldots\mu_{in}(x_n)} \quad (2)$$

The (3) equation can be stated as

$$y = \sum_{i=1}^{L} w_i k_i \quad (3)$$

where

$$w_i = \frac{\mu_{i1}(x_1)\mu_{i2}(x_2)\ldots\mu_{in}(x_n)}{\sum_{i=1}^{L}\mu_{i1}(x_1)\mu_{i2}(x_2)\ldots\mu_{in}(x_n)} \quad (5)$$

Then, variable of k can be sought by minimizing the function of

$$J = \sum_{k=1}^{N}\big(d(t) - y(t)\big)^2 = (d - Xk)^T(d - Xk) \quad [11] \quad (6)$$

Where d is the real *output* represented by matrix

$N \times 1$ (N the number of data) $d = \begin{bmatrix} d(1) \\ d(2) \\ \vdots \\ d(96) \end{bmatrix}$.

X is the matrix with size $N \times L$, where L is the amount of formed fuzzy rules.

$$X = \begin{bmatrix} w_1(1) & w_2(1) & \cdots & w_{96}(1) \\ w_1(2) & w_2(2) & \cdots & w_{96}(2) \\ \vdots & \vdots & \vdots & \vdots \\ w_1(96) & w_2(96) & \cdots & w_{96}(96) \end{bmatrix}$$

While k is the real constant that is going to be sought represented by $k = \begin{bmatrix} k_1 \\ k_2 \\ \vdots \\ k_{96} \end{bmatrix}$, a matrix in size $L \times 1$. The J function will reach the minimum value if

$$d - Xk = 0 \text{ or } Xk = d \quad (7)$$

Then, can be determined parameter k using generalized matrix inverse [12]:

$$k = X^+ d \quad (8)$$

Where $X^+ = V\Sigma^+U^T$is generalized matrix inverse from matrix X. The variable U is orthogonal matrix $m \times m$. V is orthonormal matrix $n \times n$, and Σ is matrix $m \times n$ which all entries on the diagonal is a singular entri value where zero beyond the diagonal [12]. Based on the steps above will be obtained constants k as follows

$$k = \begin{bmatrix} 0 \\ \vdots \\ 1{,}4283 \\ \vdots \\ -0{,}0119 \\ \vdots \\ 0 \end{bmatrix}$$

Then k constant substitutable in 96 rules and gained rules for the training data number -1:

[Rule 1] If the contrast is A_4 and correlation is B_5 and energy is C_3 and homogeneity is D_5 and mean is E_7 and variance is F_4 and standard deviation is G_5 and skewnes is H_5 and kurtosis is I_3 and entropy is J_6 then $y_1 = 0$.

Further for the process of defuzzification can be calculated using equation (2). Once obtain the value of defuzzification, can be done a testing system to get accuracy level, ie: accuracy, sensitivity, and specification. The formula for the accuracy level [13]:

$$accuracy = \frac{the\ number\ of\ the\ correct\ data}{the\ amount\ of\ entirely\ data} \times 100\% \quad (9)$$

$$sensitivity = \frac{TP}{TP+FN} \times 100\% \quad (10)$$

$$specification\ \frac{TN}{TN+FP} \times 100\% \quad (11)$$

D. Result

Based on the defuzzification process done toward the train data achieved the classification result of breast cancer TP=64, TN=32, FP=0, and FN=0. Thus can be calculated the accuracy level from the training data which are the accuracy, sensitivity, and specification 100%. Whereas for the test data achieved the result of accuracy, sensitivity, and specification of the test data 50%, 77,7% dan 66,67%.

The accuracy obtained from mamdani fuzzy system had been done by [8] up to 96,875% and 100% for sensitivity and specification on the training data. For the test data in mamdani fuzzy system are up to 91,67%; 93,75%, and 87,5% for accuracy, sensitivity, and specification . The comparison of the classification result from both fuzzy systems shown at Table 2.

TABEL 2. COMPARISON OF THE RESULT ZER0-ORDER SUGENO FUZZY SYSTEM TO THE MAMDANI FUZZY SYSTEM

Examining system		*Fuzzy* system	
		Zero-order Sugeno	Mamdani
Training Data	Accuracy	100%	96,875%
	Sensitivity	100%	100%
	Specification	100%	100%
Test Data	Accuracy	50%	91,67%
	Sensitivity	77,7%	93,75%
	Specification	66,67%	87,5%

E. Implementation with GUI

The last stage in this research is the application GUI (Graphical User Interface) on a fuzzy system that has been built in order that the look of fuzzy system more attractive and interactive for users. Results GUI for all training data number -1 with normal early early diagnosis is shown in Figure 4.

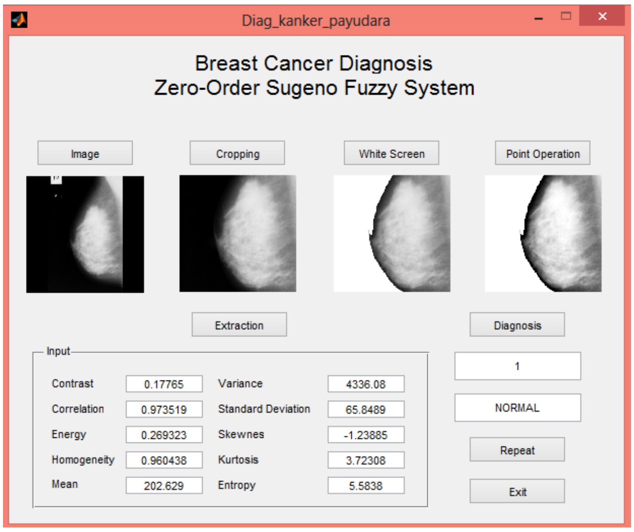

FIGURE 4. GUI DISPLAY RESULT OF TRAIN DATA 1

Figure 4 shows the classification results for the training data 1. In the column showing the image of the original image, the column cuts and a white background is an image that has been cut and removed her black background and then do the operation point on the operation point of the column. After the surgery performed extraction point in the image. Based on the extracted image is then calculated defuzzification value and classified the results. Based on Figure 4 shows that the results of data classification 1 is normal practice that has been in accordance with the initial diagnosis.

IV. CONCLUSION

The steps in constructing a zero-order Sugeno fuzzy system that starts with image processing to obtain extraction mammogram image, then fuzzification of data result of exctraction image. Based on training data used, will form 96 fuzzy rules in which the consequent determination of real constants do with generalized matrix inverse. Furthermore defuzzification process performed by the method of weight average. In the final stage, the system will be implemented fuzzy awoke with a GUI (Graphical User Interface) in order to see more attractive programs. Based on the level of accuracy obtained in this study it can be concluded that for the training data-order Sugeno fuzzy system is better in diagnosing breast cancer than using fuzzy system of mamdani. As for the test data is still needed improvements in order to improve accuracy.

Improvement and development that are likely to do in order to obtain better results of which add input variables besides extraction features such as age, weight, and quality of mammography tool that will affect the quality of the resulting image. It also adds the classification at the output, as is normal, stage 1, stage 2, stage 3 and stage 4. Furthermore, it can also make the selection of 10 extraction image is used as input to improve the accuracy and use other methods in determining the consequent parameters so that it can further optimize the results obtained.

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M – 21

Global Stability of SACR Epidemic Model for Hepatitis C on Injecting Drug Users

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Abstract— This study aims to analyze SACR model of epidemics of hepatitis C on injecting drug users. This model is represented by a system of nonlinear differential equations based on model that written by Kretzschmar M, Wiessing L (2004). In this paper will be discussed detail about the global stability of the disease free equilibrium point. The analysis results obtained to equilibrium points that is disease free and endemic equilibrium point. The Disease-free equilibrium point is local asymptotically stable if the basic reproduction number is less than one, and it is global asymptotically stable if the basic reproduction number is less than or equal to one. It means that for a long period of time, the infected population will decrease or even disappear so that the virus no longer exists in the population. Meanwhile, for the basic reproduction number is more than one, the disease-free equilibrium point is unstable and the endemic equilibrium point is local asymptotically stable. This shows that for a certain period, the Hepatitis C virus will be persist. Furthermore, based on the simulation of this model, it is found that the higher the average frequency of the use of needles together in injecting drug users, the more of the proportion of acute infection, chronic carriers and recovered. While the proportion of susceptible decreased.

Keywords: *Hepatitis C, injecting drug users, the SACR model, equilibrium points, global stability.*

I. INTRODUCTION

Epidemic models commonly used in analyzing the spread of disease is a SIR model. Based on its characteristics, this model classifying the population into three subpopulations. They are susceptible (groups of individuals free infected disease), infected (groups of individuals infected disease), and recovered (group of individuals who have been cleared of the disease). In certain diseases, some infected individuals can develop into chronic, so they need for a developing model that is able to accommodate the characteristics of the disease, such as adding a group such as carrier subpopulation.

On carrier states, susceptible individuals can be infected by contact with acute infection individual and carrier individual. Acute infection individual in a period will be recovered totally by itself, or it can be developed into a carrier virus. [1]

One of the disease which can be analyzed with the model SACR is the spread of Hepatitis C. Generally, this model can be applied to the spread of Hepatitis C because of an individual with acute infection Hepatitis C virus can be develop into chronic Hepatitis or will recovery by itself (though in small percentage). In this study the spread of Hepatitis C is focused on injecting drug user community. This is because the percentage of the case is high.

Based on the World Health Organization (WHO) data in 2009 [2], it is estimated that seven million people in Indonesia suffer Hepatitis C virus and thousands of new infections occur annually, but 90% of people are not aware of that condition. The disease can be transmitted through blood contact between individuals, and the highest risk occurs when using injecting together among drug users community. In Indonesia, the prevalence of HCV among injecting drug users reached 77.3%. [3]

Some references that support this research are project research about epidemic model with carrier population by Maia Martcheva and Carlos Castillo-Chavez (2003) [4] entitled *Diseases with chronic stage in a population with varying size*. Research about *Modelling the transmission of hepatitis C in injecting drug users* has been done by M.Kretzschmar and L. Wiessing (2004) [5]. And Dontwi, et al (2010) [6] *Mathematical modeling of Hepatitis C Virus transmission among injecting drug users and the*

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impact of vaccination. In this research will be discussed about stability analyzis of the disease free equilibrium point using a model that is developed by M. Kretzschmar and L. Wiessing (2004) [5].

II. MODEL FORMULATION

Individuals will be entered into the population because of their birth or their recruitment and leave the population through death or emigration. The total population is all individuals are susceptible, infected by hepatitis C virus or who have been recovered from hepatitis C. In this case, in susceptible individuals infected are injecting drug users. The rate of recruitment of new injecting drug users determine raising of susceptible individuals (injecting drug users) in the population. Individuals are easy to be infected with hepatitis C acute when contact with an infected individual acute or chronic. The infection rate is influenced by how often the contacts or share needles among injecting drug users. Individuals are more likely to use inject together will be more at risk to be infected with hepatitis C. Patients with hepatitis C are in the acute phase of approximately 6-10 weeks. Most people with acute infection will develop into chronic, whereas the part of them will recoverl by themself. Patients with acute hepatitis C will develop chronic liver within 15-20 years, or can also be liver cancer after 20-30 years, or it will die. Almost all of mortality from patients with hepatitis C-related complications of cirrhosis and liver cancer, so mortality due to hepatitis C virus infection is very small.

In this study, the human population at time *t* divided into four subpopulations. They are susceptible, acute infection, chronic carrier (chronically infected), and recovered (free of hepatitis C).

To simplify the model is given the following assumptions:

1. The population is constant and closed,
2. The population is homogeneous, it means that everyone has the same risk for infected the virus and the frequency of use inject together (non-sterile) is constant,
3. Individuals who haven’t been infected disease include susceptible class,
4. The mortality due to hepatitis C virus infection is ignored and it just happened natural mortality in each subpopulation.
5. Individuals who have recovered from hepatitis C, will not be infected again and become have immune to the virus Hepatitis C.

The variables and parameters which used in this study:

$S(t)$: The number of *susceptible* individuals
$A(t)$: The number of *acute infection* individuals
$C(t)$: The number of *chronic carrier* individuals
$R(t)$: The number of *recovered* individuals
$N(t)$: Total populations
B: The rate of recruitment
λ: The rate of infection
κ: Average frequency of use inject (needles) together
b_a: Probability transmission as a result of contact between susceptible individuals to acute infection individuals
b_c: Probability transmission as a result of contact between susceptible individuals with chronic individual carrier
μ: Natural mortality rate
σ_1: Individual transfer rate of acute infection becomes chronic individual carrier
σ_2: Individual transfer rate of chronic carrier into individual Recovered
ρ: The proportion of acute infection who become chronic carriers
$(1-\rho)$: The proportion of acute infection is completely cured

with $S(t), A(t), C(t), R(t) \geq 0$ *and* $B, \lambda, \kappa, b_a, b_c, \mu, \sigma_1, \sigma_2, \rho, (1-\rho) > 0$.

Based on the characteristics and the assumptions, the spread of hepatitis C can be described in the following flow chart:

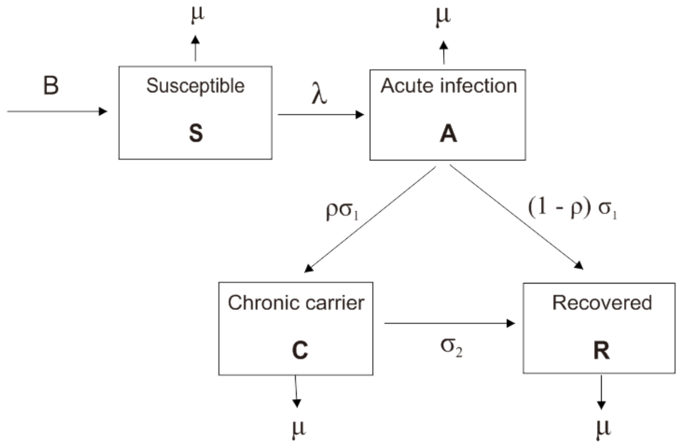

Figure 1. Flow diagram of the spread of hepatitis C in injecting drug users

Of the flow chart above, obtained by differential equations system is a model the spread of hepatitis C in injecting drug users. [5]

$$\frac{dS(t)}{dt} = B - \lambda S(t) - \mu S(t)$$
$$\frac{dA(t)}{dt} = \lambda S(t) - \sigma_1 A(t) - \mu A(t) \qquad (1)$$
$$\frac{dC(t)}{dt} = \rho\sigma_1 A(t) - \sigma_2 C(t) - \mu C(t)$$
$$\frac{dR(t)}{dt} = (1-\rho)\sigma_1 A(t) + \sigma_2 C(t) - \mu R(t)$$

with $\lambda(t) = \kappa\left(b_a \frac{A(t)}{N(t)} + b_c \frac{C(t)}{N(t)}\right)$ and $N = \frac{B}{\mu}$

Furthermore, to simplify the system, set up a proportion which compares the number of individuals in a subpopulation with the number of total population, we get

$$\frac{ds}{dt} = \mu - \lambda(t)s(t) - \mu s(t)$$
$$\frac{da}{dt} = \lambda(t)s(t) - \sigma_1 a(t) - \mu a(t) \qquad (2)$$
$$\frac{dc}{dt} = \rho\sigma_1 a(t) - \sigma_2 c(t) - \mu c(t)$$
$$\frac{dr}{dt} = (1-\rho)\sigma_1 a(t) + \sigma_2 c(t) - \mu r(t)$$

with $\lambda(t) = \kappa\big(b_a a(t) + b_c c(t)\big)$.

In this model use a parameter stating the expected value of a new case caused by infected individuals in a population of susceptible individuals. These parameters are the basic reproduction number (R_0). Based on the model (2) defined parameter

$$R_0 = \kappa\left(\frac{b_a}{(\sigma_1+\mu)} + b_c \frac{\rho\sigma_1}{(\sigma_2+\mu)(\sigma_1+\mu)}\right).$$

III. EQUILIBRIUM POINT MODEL ANALYSIS

These are equilibrium points of the system (2) are described in **theorem 1**.

Theorem 1.

(i) If $a = 0$ *then system (2) has an equilibrium point that is disease-free,* $E_0 = (s, a, c, r) = (1,0,0,0)$.

(ii) If $a \neq 0$ then system(2) has the endemic equilibrium point $E_1 = (\hat{s}, \hat{a}, \hat{c}, \hat{r})$.

Proof:

The *(s,a,c,r)* point is the equilibrium point system (2) if $\frac{ds}{dt} = \frac{da}{dt} = \frac{dc}{dt} = \frac{dr}{dt} = 0$ [7]. System (2) can be written as

$$\begin{aligned} &\mu - \lambda s - \mu s = 0 && (2a) \\ &\lambda s - \sigma_1 a - \mu a = 0 && (2b) \\ &\rho\sigma_1 a - \sigma_2 c - \mu c = 0 && (2c) \\ &(1-\rho)\sigma_1 a + \sigma_2 c - \mu r = 0 && (2d) \end{aligned}$$

with $\lambda(t) = \kappa(b_a a + b_c c)$.

(i) If $a = 0$, then from equation (2c) is obtained $c = 0$. If $a = 0$ dan $c = 0$ are substituted into the equation (2a) and (2d) obtained $s = 1$ dan $r = 0$. This proves that the disease-free equilibrium point is $E_0 = (1,0,0,0)$.

(ii) If $a \neq 0$ (which symbolized by $\hat{a}$), then the equation (2c) becomes $\rho\sigma_1\hat{a} - \sigma_2\hat{c} - \mu\hat{c} = 0$ or $\hat{c} = \frac{\rho\sigma_1}{(\sigma_2+\mu)}\hat{a}$. Furthermore, if the equation $\hat{c}$ is substituted into the equation (2b) obtained $\hat{s} = \frac{(\sigma_1-\mu)}{\kappa\left(b_a+b_c\frac{\rho\sigma_1}{(\sigma_2+\mu)}\right)}$. Consequently, from equation (2a) is obtained $\hat{a} = \frac{\mu\left(\kappa\left(b_a+b_c\frac{\rho\sigma_1}{(\sigma_2+\mu)}\right)-(\sigma_1+\mu)\right)}{\kappa\left(b_a+b_c\frac{\rho\sigma_1}{(\sigma_2+\mu)}\right)(\sigma_1+\mu)}$. Then from equation (2d) is obtained $\hat{r} = \left(\frac{(1-\rho)\sigma_2+\mu}{\mu(\sigma_2+\mu)}\right)\sigma_1\hat{a}$. So, this proves that the endemic equilibrium point is $E_1 = (\hat{s}, \hat{a}, \hat{c}, \hat{r})$ with

$$\hat{s} = \frac{(\sigma_1+\mu)}{\kappa\left(b_a + b_c\frac{\rho\sigma_1}{(\sigma_2+\mu)}\right)}; \quad \hat{a} = \frac{\mu\left(\kappa\left(b_a + b_c\frac{\rho\sigma_1}{(\sigma_2+\mu)}\right) - (\sigma_1+\mu)\right)}{\kappa\left(b_a + b_c\frac{\rho\sigma_1}{(\sigma_2+\mu)}\right)(\sigma_1+\mu)}$$

$$\hat{c} = \frac{\rho\sigma_1}{(\sigma_2+\mu)}\hat{a}; \quad \hat{r} = \frac{(\sigma_2+(1-\rho)\mu)\sigma_1}{\mu(\sigma_2+\mu)}\hat{a}.$$

IV. STABILITY ANALYSIS OF EQUILIBRIUM POINTS

In this section, will be described analysis of global stability of the equilibrium point of system (2). The stability of the equilibrium point system (2) is presented in Theorem 2, Theorem 3 and Theorem 4 as follow

Theorem 2.

(i) If $R_0 < 1$ then the disease-free equilibrium point $E_0 = (s,a,c,r) = (1,0,0,0)$ is local asymptotically stable and

(ii) If $R_0 > 1$ then the disease-free equilibrium point $E_0 = (s,a,c,r) = (1,0,0,0)$ is unstable.

Proof

The Jacobian matrix of the system (2) around the equilibrium point is $E_0 = (1,0,0,0)$ is

$$J(E_0) = \begin{bmatrix} -\kappa(b_a a + b_c c) - \mu & -\kappa b_a s & -\kappa b_c s & 0 \\ \kappa(b_a a + b_c c) & \kappa b_a s - \sigma_1 - \mu & \kappa b_c s & 0 \\ 0 & \rho\sigma_1 & -\sigma_2 - \mu & 0 \\ 0 & (1-\rho)\sigma_1 & \sigma_2 & -\mu \end{bmatrix} \qquad (3)$$

The characteristic equation of the (3) can be searched by specifying $det(J(E_0) - \gamma I) = 0$, with γ is eigenvalue and I is the identity matrix. Thus obtained:

$$(\gamma+\mu)^2\left(\gamma^2 + \left(-\kappa b_a + (\sigma_2+\mu) + (\sigma_1+\mu)\right)\gamma - \rho\sigma_1\kappa b_c - \kappa b_a(\sigma_2+\mu) + (\sigma_2+\mu)(\sigma_1+\mu)\right) = 0. \qquad (4)$$

The equation (4) can be written as

$$(\gamma+\mu)^2(\gamma^2 + q_1\gamma + q_2) = 0$$

with

$$q_1 = -\kappa b_a + (\sigma_2+\mu) + (\sigma_1+\mu)$$
$$q_2 = -\rho\sigma_1\kappa b_c - \kappa b_a(\sigma_2+\mu) + (\sigma_2+\mu)(\sigma_1+\mu).$$

Based on the equation (4), it is obtained eigenvalues$\gamma_1 = \gamma_2 = -\mu$. For other eigenvalues, Routh-Hurwitz criteria used to expand the type of stability of the characteristic equation [8]

$$\gamma^2 + q_1\gamma + q_2 = 0. \tag{5}$$

The equation$q_1 = -\kappa b_a + (\sigma_2 + \mu) + (\sigma_1 + \mu)$can be expressed as

$$q_1 = \frac{b_a(\sigma_1 + \mu)(\sigma_2 + \mu)(1-R_0) + (\sigma_2 + \mu)(b_a(\sigma_2 + \mu) + b_c\rho\sigma_1) + b_c\rho\sigma_1(\sigma_1 + \mu)}{b_a(\sigma_2 + \mu) + b_c\rho\sigma_1}$$

Furthermore, the equation $q_2 = -\rho\sigma_1\kappa b_c - \kappa b_a(\sigma_2 + \mu) + (\sigma_2 + \mu)(\sigma_1 + \mu)$ can be expressed as $q_2 = (R_0 + 1)(\sigma_1 + \mu)(\sigma_2 + \mu)$.

It is known that$R_0 < 1$, then$q_1 > 0$ and$q_2 > 0$. Based on Routh Hurwitz criteria, zero maker from the equation (5) will be negative if $\mathrm{q}_1 > 0$ and $\mathrm{q}_2 > 0$. This shows that all eigenvalues of equation (4) isnegative, so that the disease-free equilibrium point $\mathrm{E}_0 = (1,0,0,0)$is islocal asymptotically stable.

Meanwhile, if known$R_0 > 1$, then it is obtained$q_2 < 0$. The roots of the equation (5) will be different from that mark$\gamma_1 < 0$ and$\gamma_2 > 0$or the opposite. Thus, it can be said that if$R_0 > 1$, then the equation (4) has a positive eigenvalues. Therefore, the disease-free equilibrium point $E_0 = (s, a, c, r) = (1,0,0,0)$is unstable.

Theorem 3.
If $R_0 \le 1$ *then disease-free equilibrium point* $E_0 = (s, a, c, r) = (1,0,0,0)$ *is global asymptotically stable.*
Proof.

To express the global stability of the disease-free equilibrium point, it will be shown $s(t) \to 1$, $a(c) \to 0$, $c(t) \to 0$, $r(t) \to 0$ at time $t \to \infty$. Firstly, determine solutions of differential equations in system (2).

The second equation solution of the system (2) is

$$a(t) = e^{-(\sigma_1+\mu)t} \int e^{(\sigma_1+\mu)t}\lambda(t)s(t)\,dt + a_0e^{-(\sigma_1+\mu)t}$$

Because$0 \le s(t) \le 1$, then

$$\begin{aligned} a(t) &\le e^{-(\sigma_1+\mu)t} \int e^{(\sigma_1+\mu)t}\lambda(t)\,dt + a_0e^{-(\sigma_1+\mu)t} \\ &= \int_0^t e^{-(\sigma_1+\mu)(t-\tau)}\lambda(\tau)\,d\tau + a_0e^{-(\sigma_1+\mu)t} \end{aligned}$$

Furthermore, by taking lim sup for $t \to \infty$ [9], it is obtained

$$\begin{aligned} \limsup_{t\to\infty} a(t) &\le \limsup_{t\to\infty} \int_0^t e^{-(\sigma_1+\mu)\tau}\lambda(t-\tau)\,d\tau \\ &\le \limsup_{t\to\infty} \lambda(t) \int_0^\infty e^{-(\sigma_1+\mu)\tau}\,d\tau \\ &= \frac{1}{(\sigma_1 + \mu)} \limsup_{t\to\infty} \lambda \,(6) \end{aligned}$$

Then determined solutions to a third equation of the system (2) that

$$c(t) = \rho\sigma_1e^{-(\sigma_2+\mu)t} \int e^{(\sigma_2+\mu)t}a\,dt + c_0e^{-(\sigma_2+\mu)t}$$

Furthermore, by taking lim sup for$t \to \infty$, it is obtained

$$\begin{aligned} \limsup_{t\to\infty} c(t) &\le \rho\sigma_1 \limsup_{t\to\infty} \int_0^t e^{-(\sigma_2+\mu)\theta}a(t-\theta)\,d\theta \\ &\le \rho\sigma_1 \limsup_{t\to\infty} a\,(t) \int_0^\infty e^{-(\sigma_2+\mu)\theta}\,d\theta \\ &= \frac{\rho\sigma_1}{(\sigma_2 + \mu)} \limsup_{t\to\infty} a\,(t). \end{aligned} \tag{7}$$

Then inequality (6) is substituted into the inequality (7) is obtained

$$\limsup_{t\to\infty} c(t) \le \frac{\rho\sigma_1}{(\sigma_1 + \mu)(\sigma_2 + \mu)} \limsup_{t\to\infty} \lambda(t) \tag{8}$$

Then we wil discuss the rate of hepatitis C virus infection. It will be demonstrated that $\lim_{t\to\infty} \sup \lambda(t) = 0$, by taking lim sup for$t \to \infty$, then

$$\lim_{t\to\infty}\sup\lambda(t) = \lim_{t\to\infty}\sup\left(\kappa\left(b_a a(t) + b_c c(t)\right)\right).$$

Substitution inequality (6) and (8) into the above equation is obtained

$$\begin{aligned}\lim_{t\to\infty}\sup\lambda &\le \kappa b_a\frac{1}{(\sigma_1+\mu)}\lim_{t\to\infty}\sup\lambda(t) + \kappa b_c\frac{\rho\sigma_1}{(\sigma_1+\mu)(\sigma_2+\mu)}\lim_{t\to\infty}\sup\lambda(t)\\ &= \left(\frac{\kappa b_a}{(\sigma_1+\mu)} + \frac{\kappa b_c\rho\sigma_1}{(\sigma_1+\mu)(\sigma_2+\mu)}\right)\lim_{t\to\infty}\sup\lambda\\ &= R_0\lim_{t\to\infty}\sup\lambda.\end{aligned}$$

then

$$\lim_{t\to\infty}\sup\lambda \le R_0\lim_{t\to\infty}\sup\lambda$$

$$\lim_{t\to\infty}\sup\lambda - R_0\lim_{t\to\infty}\sup\lambda \le 0$$

$$\lim_{t\to\infty}\sup\lambda\,(1-R_0) \le 0.$$

as it is known$R_0 \le 1$, then $\lim_{t\to\infty}\sup\lambda = 0$.

Furthermore, with $\lim_{t\to\infty}\sup\lambda = 0$, Then based inequalities (5) and (8) were obtained $\lim_{t\to\infty}\sup a(t) = 0$ dan $\lim_{t\to\infty}\sup c(t) = 0$

And then determined the solution to fourth equations of the system (2) that is

$$r(t) = (1-\rho)\sigma_1\int_0^t e^{-\mu\omega}a(t-\omega)\,d\omega + \sigma_2\int_0^t e^{-\mu\omega}c(t-\omega)\,d\omega + r_0e^{-\mu t}$$

Furthermore, by taking lim sup for$t\to\infty$, it is obtained

$$\begin{aligned}\lim_{t\to\infty}\sup\ r(t) &\le (1-\rho)\sigma_1\lim_{t\to\infty}\sup\int_0^t e^{-\mu\omega}a(t-\omega)\,d\omega + \sigma_2\lim_{t\to\infty}\sup\int_0^t e^{-\mu\omega}c(t-\omega)\,d\omega\\ &\le \frac{(1-\rho)\sigma_1}{\mu}\lim_{t\to\infty}\sup\ a(t) + \frac{\sigma_2}{\mu}\lim_{t\to\infty}\sup c(t) \qquad (9)\end{aligned}$$

Because $\lim_{t\to\infty}\sup\ a(t) = \lim_{t\to\infty}\sup\ c(t) = 0$, then from inequality (9) is obtained $\lim_{t\to\infty}\sup\ r(t) = 0$. Thus obtained that $\lim_{t\to\infty}a(t) = 0$, $\lim_{t\to\infty}c(t) = 0$ and $\lim_{t\to\infty}r(t) = 0$.

It is known that$s(t) + a(t) + c(t) + r(t) = 1$, by taking the limit value $t\to\infty$, then obtained

$$\lim_{t\to\infty}\left(s(t) + a(t) + c(t) + r(t)\right) = \lim_{t\to\infty}1$$

$$\lim_{t\to\infty}s(t) + \lim_{t\to\infty}a(t) + \lim_{t\to\infty}c(t) + \lim_{t\to\infty}r(t) = 1$$

Because $\lim\limits_{t\to\infty}a\,(t) = 0, \lim_{t\to\infty}c(t) = 0$, and$\lim_{t\to\infty}r(t) = 0$ then$\lim_{t\to\infty}s(t) = 1.$Thus it is proved for$R_0 \le 1$then the disease-free equilibrium point $E_0 = (1,0,0,0)$ is global asymptotically stable.

Theorem 4

If $R_0 > 1$ then the endemic equilibrium point $E_1 = (\hat{s},\hat{a},\hat{c},\hat{r})$is local asymtotically stable.

Proof:

Jacobian matrix of the system (2) around the equilibrium point$E_1 = (\hat{s},\hat{a},\hat{c},\hat{r})$ is

$$J(E_1) = \begin{bmatrix} -\kappa(b_a\hat{a}+b_c\hat{c})-\mu & -\kappa b_a\hat{s} & -\kappa b_c\hat{s} & 0\\ \kappa(b_a\hat{a}+b_c\hat{c}) & \kappa b_a\hat{s}-\sigma_1-\mu & \kappa b_c\hat{s} & 0\\ 0 & \rho\sigma_1 & -\sigma_2-\mu & 0\\ 0 & (1-\rho)\sigma_1 & \sigma_2 & -\mu\end{bmatrix} \qquad (10)$$

Suppose

$$x = \kappa(b_a\hat{a}+b_c\hat{c}) = \kappa\left(b_a + \frac{b_c\rho\sigma_1}{(\sigma_2+\mu)}\right)\hat{a}\,; \quad y = \kappa b_a\hat{s} = \frac{\kappa b_a(\sigma_1+\mu)}{\kappa\left(b_a + b_c\frac{\rho\sigma_1}{(\sigma_2+\mu)}\right)}$$

$$z = \kappa b_c\hat{s} = \frac{\kappa b_c(\sigma_1+\mu)}{\kappa\left(b_a + b_c\frac{\rho\sigma_1}{(\sigma_2+\mu)}\right)}; \qquad m = (\sigma_1+\mu); \qquad n = (\sigma_2+\mu)$$

then the equation (10) can be expressed as

$$J(E_1) = \begin{bmatrix} -x-\mu & -y & -z & 0\\ x & y-m & z & 0\\ 0 & \rho\sigma_1 & -n & 0\\ 0 & (1-\rho)\sigma_1 & \sigma_2 & -\mu\end{bmatrix}$$

The characteristic equation of the equation (10) can be obtained by solving $det(J(E_2) - \gamma I) = 0$, with γ is an eigen value and I is the identity matrix. Thus, it is obtained:

$$(\mu + \gamma)\big(\gamma^3 + (n + x + \mu - y + m)\gamma^2 + (xn + \mu n - yn + mn + xm - \mu x + \mu m - z\rho\sigma_1)\gamma + (xnm - \mu yn + \mu mn - \rho\sigma_1 z\mu)\big) = 0$$

or can be expressed as

$$(\mu + \gamma)(\gamma^3 + k_1\gamma^2 + k_2 y + k_3) = 0 \qquad (11)$$

with

$$k_1 = n + x + \mu - y + m$$
$$k_2 = xn + \mu n - yn + mn + xm - \mu y + \mu m - z\rho\sigma_1$$
$$k_3 = xnm - \mu yn + \mu mn - \rho\sigma_1 z\mu$$

Based on the equation (11), it is obtained eigen value $\gamma_1 = -\mu$. For the others eigenvalues, will be used Routh-Hurwitz criteria to look at the roots of the characteristic equation $(\gamma^3 + k_1\gamma^2 + k_2 y + k_3)$. By substituting *x*, *y*, *z*, *m*, *n* into the equation k_1, k_2, and k_3, it is obtained:

$$k_1 = (\sigma_2 + \mu) + \mu R_0 + \frac{\kappa b_c \rho\sigma_1}{R_0(\sigma_2 + \mu)};$$

$$k_2 = \mu R_0(\sigma_2 + \mu) + \mu(R_0 - 1)(\sigma_1 + \mu) + \frac{\mu\kappa b_c \rho\sigma_1}{R_0(\sigma_2 + \mu)};$$

$$k_3 = \mu(R_0 - 1)(\sigma_1 + \mu)(\sigma_2 + \mu)$$

Based on the criteria of Routh-Hurwitz, zero maker of the equation$\gamma^3 + k_1\gamma^2 + k_2 y + k_3 = 0$ will be negatife if $k_1, k_2, k_3 > 0$ and $\Delta_2 = k_1 k_2 - k_0 k_3 > 0$. Because it was known $R_0 > 1$, then $k_1 > 0$, $k_2 > 0$, and $k_3 > 0$. Then,

$$\begin{aligned} \Delta_2 &= k_1 k_2 - k_0 k_3 \\ &= (\sigma_2 + \mu)\left(\mu R_0(\sigma_2 + \mu) + \frac{\mu\kappa b_c \rho\sigma_1}{R_0(\sigma_2 + \mu)}\right) \\ &\quad + \left(\mu R_0 + \frac{\kappa b_c \rho\sigma_1}{R_0(\sigma_2 + \mu)}\right)\left(\mu R_0(\sigma_2 + \mu) + \mu(R_0 - 1)(\sigma_1 + \mu) + \frac{\mu\kappa b_c \rho\sigma_1}{R_0(\sigma_2 + \mu)}\right) \end{aligned}$$

Because of $R_0 > 1$, then$\Delta_2 = k_1 k_2 - k_0 k_3 > 0$.

Thus, it is obtained all eigenvalues of equation (11) is negative, so it is proved that if $R_0 > 1$, then the endemic equilibrium point $E_1 = (\hat{s}, \hat{a}, \hat{c}, \hat{r})$is local asymptotically stable.

V. MODEL SIMULATION

In this section will discusses the numerical simulation of the model to provide a simulation of the spread of hepatitis C model in injecting drug users by using MAPLE 15. Given the values of the following parameters $b_a = 0{,}3, b_c = 0{,}03$ [5], $\mu = 0{,}056$, $\frac{B}{N} = 0{,}056$, $\sigma_1 = 5, \sigma_2 = 0{,}05, \rho = 0{,}8$ and some specific initial value.

To simulate the conditions $R_0 < 1$, the value is taken $\kappa = 3$ and given initial values $s(0) = 0{,}002$, $a(0) = 0{,}008$, $c(0) = 0{,}45$, $r(0) = 0{,}54$. It is obtained,

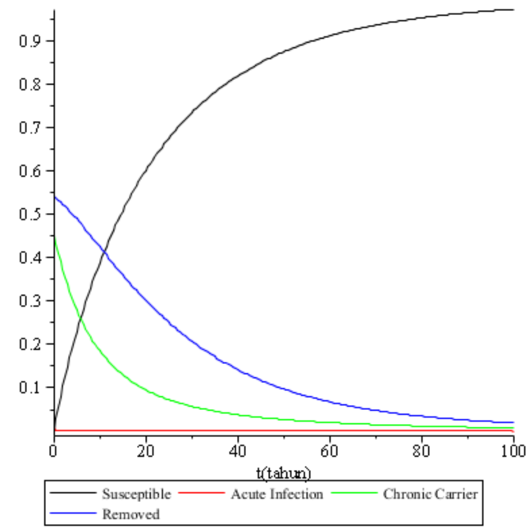

Figure 2. Simulation of the system (3.7) for$R_0 = 0{,}8497283259 < 1$

Furthermore, given also some initial values for each proportion of individuals susceptible, acute infection, chronic carrier as follows (0, 0.06, 0.015, 0.2), (0, 0.14, 0.25, 0.3), and (0, 0.49, 0.2, 0.1) to obtain a phase portrait of system solutions in the field of s, a, c. Based on these parameter values and initial values given phase portraits obtained in the field s, a, c that is shown in Figure 2.

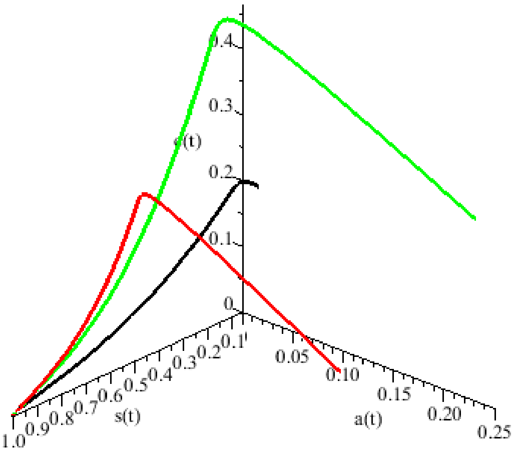

Figure3. Phase portrait in the fields,*a*,*c* for$R_0 = 0{,}8497283259 < 1$

Based on Figure 2 and Figure 3 shows that the proportion of susceptible individuals is increasing to the point 1 over time. As for the proportion of individuals acute infection, chronic (chronic carrier), and free (recovered) from Hepatitis C virus decreases towards zero. The decline in the proportion of individuals in acute infection and chronic carrier to the point of zero indicates that the proportion of individuals in acute infection and chronic carrier is die out (no infection). This simulation shows that some different initial values and when $R_0 < 1$ solution of the system (2) moves toward the equilibrium point E_0. So it can be said that when $R_0 < 1$, hepatitis C will disappear from the population.

Then, for $R_0 > 1$, given the initial value $s(0) = 0{,}8995$, $a(0) = 0{,}0005$, $c(0) = 0{,}05$, $r(0) = 0{,}05$ to obtain a phase portrait projection solutions proportion of susceptible individuals, acute infection, chronic carrier, recovered against time t as in Figure 4, Figure 5 and Figure 6.

The numerical value for E_1 when $\kappa = 6$ adalah $\hat{s} = 0{,}588423364$, $\hat{a} = 0{,}004558601980$, $\hat{c} = 0{,}1720227162$, $\hat{r} = 0{,}2349953177$. For $\kappa = 8$ obtain $\hat{s} = 0{,}4413175231$, $\hat{a} = 0{,}006187938827$, $\hat{c} = 0{,}2335071255$, $\hat{r} = 0{,}3189874126$. Meanwhile, for $\kappa = 10$ obtained $R_0 = 2{,}832427753$, $\hat{s} = 0{,}3530540184$, $\hat{a} = 0{,}007165540935$, $\hat{c} = 0{,}2703977711$, $\hat{r} = 0{,}3693826695$.

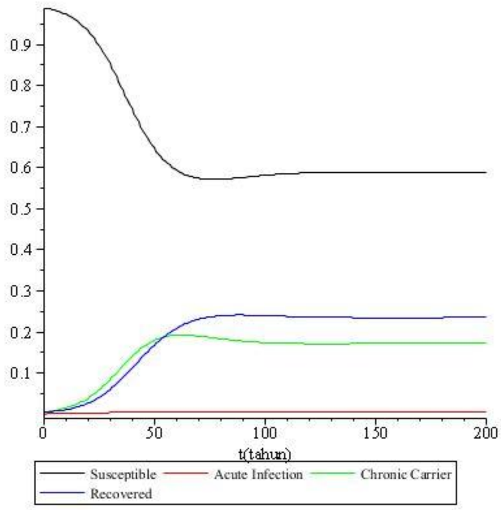

Figure 4.Simulation System (2) for$R_0 = 1{,}699456652$ with$\kappa = 6$

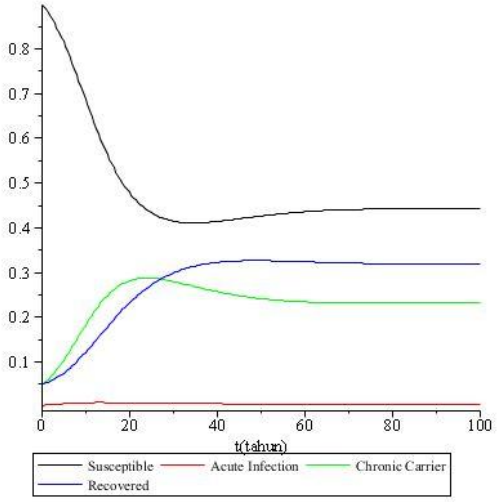

Figure 5.Simulation System (2) for$R_0 = 2{,}265942202$ with $\kappa = 8$

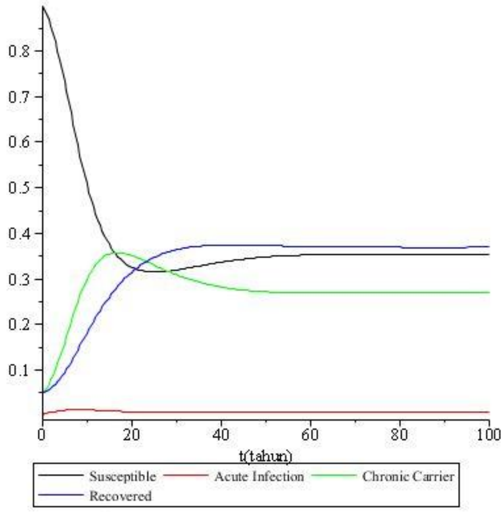

Figure 6.Simulation System (2) for$R_0 = 2{,}832427753$ with $\kappa = 10$

Furthermore, given some initial values for for each proportion of individuals susceptible, acute infection and chronic carrier are (0, 0.06, 0.015, 0.2), (0, 0.14, 0.25, 0.3), and (0, 0.49, 0.2, 0.1). To show the behavior solution of the system (2) around the endemic equilibrium point with parameter values $\kappa = 8$, can be seen in Figure 7.

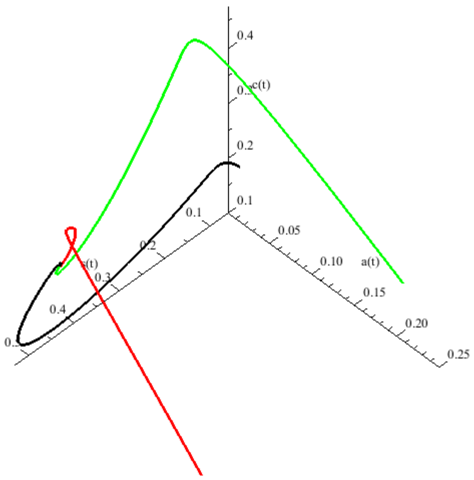

Figure 7. Phase portrait for $R_0 > 1$

Based on the simulation of Figure 4, Figure 5 and Figure 6, show that when the frequency of people using needles together (κ) is increase, the proportion of susceptible individuals decreases, while the proportion of acute infection, chronic carrier and recovered increase in proportion to the value of parameter κ. This means that if the average frequency of people using needles together is bigger, then the infection rate would be greater, which in turn resulted in the growing spread of Hepatitis C.

Based on the simulation of Figure 4, Figure 5, Figure 6 and Figure 7 shows that the proportion fluctuated. This is a result of contact individuals susceptible to hepatitis C patients with acute and chronic. When the proportion of susceptible individuals is dropped, the proportion of acute infection and chronic carrier increases and towards a point. Increasing the proportion of individuals in acute infection and chronic carrier, resulting in increased and the proportion of individuals recovered towards the equilibrium point E_1.

The solution of system (2) given initial values of different moving toward to endemic equilibrium pointE_1 and away from disease free equilibrium E_0. This means that the simulation results with the analytic results in Theorem 4 indicates that when $R_0 > 1$ the endemic equilibrium point E_1 is asymtotically stable and Theorema 2 (ii) which states that when $R_0 > 1$ the disease free equilibrium point E_0 is unstable.

VI. CONCLUSION

Based on the above discussion, it can be concluded that the model form of the spread of hepatitis C in injecting drug users is nonlinear differential equations system in first order. Furthermore, Based on model analysis, resulting the disease free equilibrium point and the endemic equilibrium pointThe spread of hepatitis C virus in injecting drug users model have the basic reproduction number R_0which is an indicator of the spread of disease. If $R_0 < 1$ then the hepatitis C virus does not attack the population or gradually disappeared, whereas if $R_0 > 1$ then the disease is endemic and is very likely to spread. In conditions of $R_0 < 1$, the disease-free equilibrium point is asymptotically stable and when $R_0 \leq 1$ is global asymtotically stable. Meanwhile, when$R_0 > 1$ the disease free equilibrium point is unstable and the endemic equilibrium point is local asymtotically stable.

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M – 22

The Greatest Solution of Inequality A O Kross X Less Than X Less Than B O Dot X By Using A Matrix Residuation Over An Idempotent Semiring

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Abstract— *A complete idempotent semiring has a structure which is called a complete lattice. Because of the same structure as the complete lattice then inequality of the complete idempotent semiring can be solved a solution by using residuation theory. One of the inequality which is explained is* $A\otimes X \le B$ *where matrices A,X,B with entries in the complete idempotent semiring S. Furthermore, introduced dual product* $\odot$, *i.e. binary operation endowed in a complete idempotent semiring S and not included in the standard definition of complete idempotent semirings. A solution of inequality* $A\otimes X \le B$ *can be solved by using residuation theory. Because of the guarantee that for each isotone mapping in complete lattice always has a fixed point, then is also exist in the complete idempotent semiring. This of the characteristics is used in order to obtain the greatest solution of inequality* $A\otimes X \le X \le B\odot X$.

Keywords: complete lattice, complete idempotent semiring, dual Kleene Star, dual product, residuation theory

I. INTRODUCTION

An idempotent semirings S is a semiring which addition operation $\oplus$ is idempotent. The addition $\oplus$ and multiplication $\otimes$ have neutral elements are denoted ε and e. Idempotent semiring is said to be complete if it is closed for infinite sums and multiplication $\otimes$ distributes over infinite sums.

Because of idempotent property over its sums, idempotent semiring can be endowed ordered relation , denoted $\le$. A complete idempotent semiring has a same structure with complete lattice. Because of the same structure of its, an inequality of complete idempotent semiring can be had its solution with residuation theory.

Beside of scalar, the concept of residuation can be applied for a equality which is be explain is a inequality $A\otimes X \le B$ with matrices A, X, B with entries from a complete idempotent semiring S. A greatest solution of the inequality $A\otimes X \le B$ can be found with residuation theory. First, Baccelli (1992) research how to get the greateast solution of the inequality $A\otimes X \le B$ with matrices A ∈ $S^{n\times n}$ and X ∈ $S^{n\times 1}$. After that, the research is be continued about a greatest solution of the inequality $A\otimes X \le B$ with matrices A ∈ $S^{n\times p}$ and X ∈ $S^{p\times m}$.

As we know, the complete idempotent semiring has a property that its distributes $\otimes$ over infinite sums $\oplus$. Generally, multiplication $\otimes$ distribute over ∧ can't hold, because its just hold that a ⊗ (b ∧ c) j (a⊗b)∧ (a⊗c). The property is distribite multiplication ⊗ over ∧ in the complete idempotent semiring can be hold if its has nessesary condisition that element a has a invers, so that a ⊗ (b ∧ c) = (a ⊗ b) ∧ (a ⊗ c). With that the condition, can be defined new operation which has a property of distribute multiplication ⊗ over ∧. Hardouin introduce a duality of multiplication ⊗ is dual product which is $\odot$ distribute over ∧. Beside of the dual product in the complete idempotent semiring, it is given dual product in idempotent semiring for two matrices $A\in S^{p\times n}$ and $B\in S^{n\times q}$, is denoted $A\odot X$, is defined as $\left(A\odot X\right)_{ij} = \wedge_{k=1,2,\ldots,n}\left(a_{ik}\odot x_{kj}\right)$ with ∧ represents the greatest lower bound..

After that, about a fixed point equation in a complete lattice also can be applied in the complete idempotent semiring. If is given a complete idempotent semiring S and a mapping $f: S\mapsto S$ so its can be collected a nonempty set $\left\{x\in S \,\middle|\, f\left(x\right)=x\right\}$. Because of order relation in S, its also can be collected a nonempty set $\left\{x\in S \,\middle|\, f\left(x\right)\le x\right\}$ and $\left\{x\in S \,\middle|\, f\left(x\right)\ge x\right\}$. In case of matrix, also can be collected $\left\{X\in S^{n\times m} \,\middle|\, f\left(X\right)=X\right\}$, $\left\{X\in S^{n\times m} \,\middle|\, f\left(X\right)\le X\right\}$ and $\left\{X\in S^{n\times m} \,\middle|\, f\left(X\right)\ge X\right\}$ with f a isotone mapping. The research before, had be researched about the solution of inequality $A \otimes X \leq B$, is defined the isotone mapping $L_A : X \to A \otimes X$, so that the property of the isotone mapping L_A , can be collected a nonempty set $\left\{ X \in S^{n \times m} \left| L_A \left(X \right) = X \right. \right\}$ and $\left\{ X \in S^{n \times m} \left| L_A \left(X \right) \leq X \right. \right\}$.

The research is continued about how to find the least solution of an inequality $A \odot X \geq B$, with is defined a isoton mapping $\wedge_A : X \mapsto A \odot X$, so that the property of the isoton mapping $\wedge_A$ can be collected a nonempty set $\left\{ X \in S^{n \times m} \left| \wedge_A \left(X \right) = X \right. \right\}$ and $\left\{ X \in S^{n \times m} \left| \wedge_A \left(X \right) \geq X \right. \right\}$. With the guarantee of the matrix X which hold $L_A \left(X \right) \leq X$ and $\wedge_A \left(X \right) \geq X$ and also the property $X \geq A \otimes X \Leftrightarrow X \leq A \setminus X \Leftrightarrow X = A^* \otimes X \Leftrightarrow$ $X = A^* \setminus X$ dan $X \leq B \odot X \Leftrightarrow X \geq B \bullet X \Leftrightarrow X = B_* \odot X \Leftrightarrow X = B_* \bullet X$, so that can research how the characteristic of the solution X which hold a inequality $A \otimes X \leq X \leq B \odot X$.

II. RESEARCH METHOD

In the research, a researcher has use some step to find a goal. First, its is studied about semiring theory, especially about a definition and a property of complete idempotent semiring. After that, is be researched that there is the relationship between the complete idempotent semiring and complete lattice. Because of the relationship between them, has be understood residuation theory which hold in complete lattice, especially a lower semicontinous mapping and a upper semicontinous mapping, the definition and the property of residual mapping and dual residual mapping. Because of the same structure between complete idempotent semiring and complete lattice, the definition of the lower semicontinous mapping and the definition of the upper semicontinous mapping also hold in the complete idempotent semiring. Beside that, the property of the residuated mapping and the property of the dual residuated mapping also hold in the complete idempotent semiring. So that, residuation theory can be applied for find the greatest solution of the inequality $A \otimes X \leq B$ and the least solution of the inequality $A \odot X \geq B$ with matrices A, X, B over complete idempotent semiring.

After that, is defined closure mapping and its characteristics is used for find the least solution of the inequality $A \odot X \geq B$. The research is be continued to find the greatest solution of the inequality $A \otimes X \leq B$ with residuation theory. First, is researched the greatest of the inequality $A \otimes X \leq B$ with matrices $A \in S^{n \times n}$, $X \in S^{n \times 1}$. The research is be continued the greatest solution of the inequality $A \otimes X \leq B$ with matrices $A \in S^{n \times n}$, $X \in S^{n \times n}$ and the solution of the inequality $A \otimes X \leq B$ with matrices $A \in S^{n \times p}$, $X \in S^{p \times m}$.

Multiplication is endowed in idempotent semiring, distribute over $\wedge$, so is defined new operation is called dual product in idempotent semiring and dual product in matrix over idempotent semiring. The research is continued about the least solution of the inequality $A \odot X \geq B$, with defined dual residuated mapping

III. MATHEMATICAL BACKGROUND

III.1. RESIDUATION THEORY

Residution has propose for solving unique an equation $f(x) = b$ with inverting isotone mapping f from a complete idempotent semiring D in to another complete idempotent semiring E .

1. f not surjective $\Rightarrow$ $f(x) = b$ will have no solution for some value b .
2. f not injective $\Rightarrow$ $f(x) = b$ will have nonunique subsolution for some value b .

The solution $f(x) = b$ is to consider the subset subsolutions $f(x) = b$, that is value of x satisfying $f(x) \leq b$. These following step are used for solving subsolutions $f(x) = b$:

1. This subset of subsolution is nonempty.
2. Choose the upper bounds of the subset.
3. If the upper bounds of the subset exists, it remains to be checked whether the upper bound itself is the subsolution $f(x) = b$. The other words, the subset of subsolutions $f(x) = b$ has a maximum element , is denoted $f^{\#}(b)$, so we can get

$$f^{\#}(b) = \oplus_{\{x|f(x)\le b\}} x \text{ and } f(f^{\#}(b)) \le b$$

4. After we got the maximum element of the subset of subsolutions, we have could be checked whether its maximum element, in this case $f^{\#}(b)$ satisfying an equation $f(x)=b$. If yes, $f^{\#}(b)$ is the solution of the equation $f(x)=b$.

Beside to get the solution $f(x)=b$, for solving $f(x)=b$ can also get supersolutions $f(x)=b$, that is value of x satisfying $f(x)\ge b$. These following step are used for solving supersolutions $f(x)=b$:

1. This subset of supersolution is nonempty, so can be choosed the lower bounds of the subset of supersolutios $f(x)=b$.
2. If the lower bounds of the subset exists, it remains to be checked whether the lower bound itself is the supersolution $f(x)=b$. The other words, the subset of supersolutions $f(x)=b$ has a minimum element , is denoted $f^{b}(b)$, so we can get
$$f^{b}(b) = \oplus_{\{x|f(x)\ge b\}} x \text{ and } f(f^{b}(b)) \ge b$$
3. After we got the minimum element of the subset of supersolutions, we have could be checked whether its minimum element, in this case $f^{b}(b)$ satisfying an equation $f(x)=b$.
4. If yes, $f^{b}(b)$ is the solution of the equation $f(x)=b$.

Definition 3.1. *Let order set D and E with ordered sets $\le$. An isotone mapping f:D → E is said to be* ***residuated*** *if for all y ∈ E, the least upper bound of subset $\{x\in D | f(x)\le y\}$ is exist and is an element of that subset (that maximum element is exist), that maximum element is denoted $f^{\#}(y)$. All of the element x which hold the equality are called subsolutons of the equality f(x) = y.*

Definition 3.2. *Let order set D and E with ordered sets $\le$. An isotone mapping g:D → E is said to be* ***dually residuated*** *if for all y ∈ E, the greatest lower bound of subset $\{x\in D | g(x)\ge y\}$ is exist and is an element of that subset (that minimum element is exist), that minimum element is denoted $f^{b}(y)$. All of the element x which hold the equality are called supersolutons of the equality g(x) = y.*

Theorem 3.3. *If let f be an isotone mapping $f: E\to F$ with E, F are complete idempotent semirings, a bottom element of E is denoted ε_E, a top element of E is denoted T_E, the following statements are equivalent :*

1. *A mapping f is residuated.*
2. $f(\varepsilon_E)=\varepsilon_F$ *and* $f(\oplus_{x\in X} x) = \oplus_{x\in X} f(x)$ *for all* $X\subseteq E$ *(that f is lower – semicontinuous).*
3. $f(\mathrm{T}_E)=\mathrm{T}_F$ *and* $f^{\#}(\wedge_{y\in Y} y) = \wedge_{y\in Y} f^{\#}(y)$ *for all* $Y\subseteq F$ *(that* $f^{\#}$ *is upper – semicontinuous).*

Theorem 3.4. *If let g be an isotone mapping $g: E\to F$ with E, F are complete idempotent semirings, a bottom element of F is denoted ε_F, a top element of F is denoted T_F, the following statements are equivalent :*

1. *A mapping g is dually residuated.*
2. $g(\mathrm{T}_E)=\mathrm{T}_F$ *and* $g(\wedge_{x\in X} x) = \wedge_{x\in X} g(x)$ *for all* $X\subseteq E$ *(that g is upper – semicontinuous).*
3. $g(\varepsilon_E)=\varepsilon_F$ *and* $g^{b}(\oplus_{y\in Y} y) = \oplus_{y\in Y} g^{b}(y)$ *for all* $Y\subseteq F$ *(that* g^{b} *is lower – semicontinuous).*

III.2. CLOSURE MAPPING

This section, will be explain a closure mapping and that relationship with a residuated mapping and a dually residuated mapping

Definition 3.5. *Let an idempotent semiring S and an isotone mapping* $h: S \mapsto S$ *. If* $h \circ h = h \geq Id_S$ *h is a closure mapping. If* $h \circ h = h \leq Id_S$ *, h is a dual closure.mapping.*

Theorem 3.6 *Let semiring S. If a mapping* $h: S \mapsto S$ *is a residuated mapping, then the following statements are equivalent :*

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1. *h is a closure mapping*
2. $h^{\#}$ *is a dual closure mapping*
3. $h \circ h^{\#} = h^{\#}$
4. $h^{\#} \circ h = h$

IV. THE GREATEST SOLUTION OF AN INEQUALITY $A \otimes X \leq B$ WITH MATRIX A ∈ $S^{N \times P}$ AND B ∈ $S^{N \times M}$

For solving an inequality $A \otimes X \leq B$ with A ∈ $S^{n \times p}$ dan B ∈ $S^{n \times m}$ for using residuation theory. In this case for getting the solution of the inequality $A \otimes X \leq B$ with A ∈ $S^{n \times p}$ and B ∈ $S^{n \times m}$, that is

Given a complete semiring idempotent S, matrix A ∈ $S^{n \times p}$ dan B ∈ $S^{n \times m}$. Defined a mapping L_A $S^{n \times p} \to S^{n \times m}$, that is

$$L_A : X \mapsto A \otimes X \qquad (1)$$

Generally, the solution of the inequality $A \otimes X \leq B$ for A ∈ $S^{n \times p}$, X ∈ $S^{p \times m}$ and B ∈ $S^{n \times m}$ are $\left[L_A^{\#}(B)\right]_{ik} = \wedge_{j=1}^{n}\left(A_{ji} \setminus b_{jk}\right) = \left[A \setminus B\right]_{ik}$

Because of all B ∈ $S^{n \times m}$, there is exist a maximal element $L_A^{\#}(B)$ yang $A \otimes X \leq B$ then can be create a isotone mapping $L_A^{\#}$: $S^{n \times m} \to S^{p \times m}$. Furthetmore, a mapping $L_A^{\#}$ is defined for all X ∈ $S^{n \times m}$

$$L_A^{\#} : S^{n \times m} \to S^{p \times m}$$

$$X \mapsto A \setminus X$$

With $\left[A \setminus X\right]_{ik} = \wedge_{j=1}^{n}\left(A_{ji} \setminus x_{jk}\right)$ is called a residuated mapping L_A with A ∈ $S^{n \times p}$.

V. THE LEAST SOLUTION OF AN INEQUALITY $A \odot X \geq B$ WITH MATRIX A ∈ $S^{N \times P}$ AND B ∈ $S^{N \times M}$

V.1 Dual Product

Distributive multiplication ⊙ over ∧ isn't satisfied in a idempotent semiring, generally, is added necessary condition that the idempotent semiring is semifield. That is motivated definition ⊙ is called dual product.

Definition 5.1. *Let a complete idempotent semiring S. Dual product in S is denoted* ⊙ *is biner operation which is assumed have the following characteristics :*

1. *Operation* ⊙ *is assosiative.*
2. *(S,* ⊙ *) has a netral element e.*
3. *Operation* ⊙ *is distributive over* ∧ *for infinite element, that is u* $\forall a_i \in S, \left(\wedge_{i \in I} a_i\right) \odot b = \wedge_{i \in I}\left(a_i \odot b\right)$
4. *Ttop element* T *is as absorb element over* ⊙ *, that is* $\left(\forall a \in S, \mathrm{T} \odot a = a \odot \mathrm{T} = \mathrm{T}\right)$

Then, will let dual product definition for matrix :

Definition 5.2. *Let a complete idempotent semiring S. Matrix A* ∈ $S^{n \times p}$*,B* ∈ $S^{p \times m}$*, then* $A \odot B$ *is defined:*

$$\left(A \odot B\right)_{ij} = \wedge_{k=1,2,\ldots,p}\left(a_{ik} \odot b_{kj}\right)$$

For all $i = 1, 2, \ldots, n$ *and* $j = 1, 2, \ldots, m$.

V.2. The Least Solution of An Inequality $A \odot X \geq B$ **with A ∈ $S^{n \times p}$ and B ∈ $S^{n \times m}$**

Theorem 5.3. *Let a complete idempotent semiring S and matrix* $A \in S^{n \times p}$. *A mapping*

$$\wedge_A : S^{p \times m} \mapsto S^{n \times m}$$
$$X \mapsto A \odot X$$

Is a dually residuated mapping and that dual residual can be denoted

$$\wedge_A^b : S^{n \times m} \mapsto S^{p \times m}$$
$$X \mapsto A \bullet X$$

With the definition operation is

$$[A \bullet X]_{ij} = \oplus_{k=1}^{n} \left(A_{ki} \bullet x_{kj} \right) \qquad (2)$$

$\mathrm{T} \bullet x = \varepsilon, \varepsilon \bullet x = \mathrm{T}$, and $\varepsilon \bullet \varepsilon = \varepsilon$

VI. THE SOLUTION OF INEQUALITY $A \otimes X \leq X \leq B \odot X$

VI. 1 Fixed Point Equations and Inequality of Fixed Point.

Definiton 6.1. *Let a set A and function* $f : A \to A$. *An element* $a \in A$ *is called a* ***fixed point*** *of function* f *if* $f(a) = a$. *Furthermore,* a *can be called a solution of the fixed point equation* $x = f(x)$. *When the set* A *is endowed with a ordered relation* $\leq$, *can be defined* ***prefixed point*** *of* f , *that is* $a \in A$ *is called* ***prefixed points*** *of* f *if* $f(a) \leq a$. *Besides that, can also be defined a post-fixed point of* f , *that is* $a \in A$ *is called* ***post-fixed points*** *of* f *if* $f(a) \geq a$.

Because the complete idempotent semiring S is the ordered set with the ordered relation $\leq$ then it can be defined a fixed point equation of a isoton mapping $f : S \to S$, that is :

$$f(x) = x \qquad (3)$$

and fixed point inequality $f : S \to S$ has the following hold:

$$f(x) \leq x \qquad (4)$$
$$f(x) \geq x \qquad (5)$$

VI.2 Kleene Star

Definition 6.2. *Let a complete idempotent semirings S. Kleene star is a mapping.*

$$k : S \mapsto S, a \mapsto a* = \oplus_{i=0}^{\infty} a^i$$

With $a^{i+1} = a \otimes a^i$ *and* $a^0 = e$.

Kleene star can also be applied to a square matrix in the complete idempotent semiring.

Definition 6.3. *Let a complete idempotent semiring S. Kleene Star of matrix* $A \in S^{n \times n}$ *is defined by*

$$K : S^{n \times n} \mapsto S^{n \times n}, A \mapsto A* = \oplus_{i=0}^{\infty} A^i$$

with $A^0 = E$, *E an identity matrix and*

$$A^k = A \otimes A^{k-1}.$$

Propotition 6.4. *Let a complete idempotent semiring S. Matrix* $A \in S^{n \times n}$ *and* $X \in S^{n \times p}$. *A mapping* L_{A^*} : $S^{n \times p} \to S^{n \times p}$, $X \mapsto A^* \otimes X$ *is a closure mapping, so that is,*

$$A^* \otimes A^* \otimes X = A^* \otimes X$$

As a consequence,

$$X = A^* \otimes X \Leftrightarrow X \in \operatorname{Im} L_{A^*} \qquad (3)$$

Lemma 6.5. *Given a complete idempotent semiring S, matrices A* $\in S^{n\times n}$ *and X* $\in S^{n\times p}$
The following equivalences hold:

1. $X \le A \setminus X$
2. $X \ge A \otimes X$
3. $X = A^* \otimes X$
4. $X = A^* \setminus X$

VI.3. Dual Kleene Star

Definition Kleene star explain that Kleene Star is the sum of infinite ⊕ of an element in a complete idempotent semiring. The following duality of Kleene Star i.e. dual Kleene Star which is meet ∧ infinite. of an element in a complete idempotent semiring.

Definition 6.6. *Given a complete idempotent semiring S. Dual Kleene Star is a mapping*

$$l : S \mapsto S, b \mapsto b_* = \wedge_{i=0}^{\infty} b^{\odot i}$$

where $b^{\odot i+1} = b \odot b^{\odot i}$ *and* $b^{\odot 0} = e$

Selanjutnya, pendefinisian dual star dapat pula diaplikasikan dalam kasus ma-trik, sebagaimana dijelaskan mengenai dual star pada matrik.

Definisi 6.7. *Given a complete idempotent semiring S. Dual Kleene Star for matrix B* $\in S^{n\times n}$ *is defined by*

$$B_* = \wedge_{k=0}^{\infty} B^{\odot^k}$$

Where $B^{\odot i+1} = B \odot B^{\odot i}$ *and* $B^{\odot 0} = E$

Sifat 6.8. *Given matrix* $B \in S^{n\times n}$. *A mapping* $\wedge_{B_*}$ *is upper semicontinuous mapping and according to Defintioni 5.6., a mapping* $\wedge_{B_*} : S^{n\times p} \mapsto S^{n\times p}$, $X \mapsto B_* \odot X$ *is a dual closure mapping. So that,*

$$B_* \odot B_* \odot X = B_* \odot X \qquad (4)$$

As consequence is

$$X = B_* \odot X \Leftrightarrow X \in \mathrm{Im} \wedge_{B_*} \qquad (5)$$

Propotition 6.9. *Given a complete idempotent semiring S, matrices B* $\in S^{n\times n}$ *and X* $\in S^{n\times p}$*, then the following equivalences hold :*

1. $X \le B \odot X$
2. $X \ge B \bullet X$
3. $X = B_* \bullet X$
4. $X = B_* \odot X$

Proposisi 6.10. *Given a complete idempotent semiring S, matrices A, B* $\in S^{n\times n}$ *and X* $\in S^{n\times m}$. *The following equivalences hold :*

$$A \otimes X \le X \le B \odot X \Leftrightarrow X \in \mathrm{Im} L_{A^*} \cap \mathrm{Im} \wedge_{B_*}$$

Proposisi 6.11. *Given a complete idempotent semiring S, and matrices A, B, G* $\in S^{n\times n}$. *The greatest of solution is X which is hold :*

$$A \otimes X \le X \le B \odot X \text{ dan } X \le G$$

is

$$X = \left(\left(B_* \bullet A^*\right)^*\right) \setminus G$$

Proof :

1. Proved that $A \otimes X \le X \le B \odot X$ dan $X \le G \Rightarrow X \le \hat{X}$. According to Propotition 6.10, $A \otimes X \le X \le B \odot X \Leftrightarrow X \in \mathrm{Im} L_{A^*} \cap \mathrm{Im} \wedge_{B_*}$. That mean matrix X must hold $X = B_* \bullet (A^* \otimes X)$.

$$X = B_* \bullet (A^* \otimes X)$$
$$\Leftrightarrow X = (B_* \bullet A^*) \otimes X)$$
$$\Leftrightarrow X = ((B_* \bullet A^*)^*) \setminus X$$

Therefore, $A \otimes X \le X \le B \odot X$ and $X \le G \Rightarrow X = ((B_* \bullet A^*)^*) \setminus X$ and $X \le G$. Attention that Theorem 6.5, $X = ((B_* \bullet A^*)^*) \setminus X \Leftrightarrow (B_* \bullet A^*) \otimes X \le X$. Bacause of $(B_* \bullet A^*) \otimes X \le X$ and $X \le G$ then $X \le \hat{X} = ((B_* \bullet A^*)^*) \setminus G$.

2. Proved that $\hat{X} \le G, \hat{X} = A^* \otimes \hat{X}$.

First, will proved that $\hat{X} \in \operatorname{Im} L_{A^*}$ is equivalent $\hat{X} = A^* \otimes \hat{X} = A^* \setminus \hat{X}$. According to Lemma 6.5, $\hat{X}$ hold by

$$(B_* \bullet A^*) \otimes \hat{X} \le \hat{X} \le (B_* \bullet A^*) \setminus \hat{X} \qquad (9)$$

Because of an isotone mapping L_{A^*} and $\hat{X} \le (B_* \bullet A^*) \setminus \hat{X}$, then $A^* \otimes \hat{X} \le A^* \otimes ((B_* \bullet A^*) \setminus \hat{X})$. Therefore,

$$A^* \setminus \hat{X} \ge A^* \setminus ((B_* \bullet A^*) \setminus \hat{X})$$

Attention that

$$A^* \setminus ((B_* \bullet A^*) \setminus \hat{X}) = ((B_* \bullet A^*) \otimes A^*) \setminus \hat{X}$$
$$= (B_* \bullet (A^* \otimes A^*)) \setminus \hat{X}$$
$$= (B_* \bullet A^*) \setminus \hat{X}$$

So that, be got $A^* \setminus \hat{X} \ge (B_* \bullet A^*) \setminus \hat{X}$. According to inequality 9, $(B_* \bullet A^*) \setminus \hat{X} \ge \hat{X}$. Consequently, get inequality $A^* \setminus \hat{X} \ge (B_* \bullet A^*) \setminus \hat{X} \ge \hat{X}$. Thus $A^* \setminus \hat{X} \ge \hat{X}$. After that, $\hat{X} \ge A^* \setminus \hat{X}$ (because of $A^* \ge E$) then $A^* \setminus \hat{X} = \hat{X}$, i.e. $\hat{X} \in \operatorname{Im} L_{A^*}$.

The second, proved $\hat{X} \in \operatorname{Im} \wedge_{B_*}$, i.e. $\hat{X} = B_* \odot \hat{X} = B_* \bullet \hat{X}$. From the equation 9. Be got $\hat{X} \ge (B_* \bullet A^*) \otimes \hat{X} = B_* \bullet (A^* \otimes \hat{X}) = B_* \bullet \hat{X}$ (because of $\hat{X} = A^* \otimes \hat{X}$). The other side, $B_* \le E^{\odot}$. Because of $\wedge_{B_*}$ an isotone mapping, then $B_* \odot \hat{X} \le E^{\odot} \odot \hat{X}$. Consequently, can be got $\hat{X} \le B_* \bullet \hat{X}$. So that, $\hat{X} = B_* \bullet \hat{X} = B_* \odot \hat{X}$.

Third, because of inequality $(B_* \bullet A^*)^* \ge E$, then $(B_* \bullet A^*)^* \odot G \ge E \odot G$. Consequently, can be got $(B_* \bullet A^*)^* \setminus G \le G$. So that, be got $\hat{X} \le G$.

VII. KESIMPULAN DAN SARAN

VII.1 Conclusion

In this paper, can be concluded that the same structure beetwen a complete idempotent semiring and a complete lattice give more advantages for solving inequality of a complete idempotent semiring by using residuation theory. Given complete idempotent semiring S , then

1. Solution of inequality $A \otimes X \le B$ with matrices $A \in S^{n \times p}$ and $B \in S^{n \times m}$ is $\wedge_{j=1}^{n} (A_{ji} \setminus b_{jk}) = [A \setminus B]_{ik}$.
2. Solution of inequality $A \odot X \ge B$ with matrices $A \in S^{n \times p}$ and $B \in S^{n \times m}$ is $(A \bullet X)_{ij} = \oplus_{k=1}^{n} (A_{ki} \bullet x_{kj})$.
3. Solution of inequality $A \otimes X \le X \le B \odot X$ dan $X \le G$ dengan $A, B, G \in S^{n \times n}$ can be get with formula $\hat{X} = ((B_* \bullet A^*)^*) \setminus G$.

VII.2 Suggestion

1. In case that relation of Propotition 6.10 and Propotition 6.11, is necesarry explanation about the best approximation terbaik an element in G by another element in $\gamma^{b}_{L_{A^*}}$ but that is explained in this paper, yet. So that, can be added for completing the relationship beetwen Proposisi 6.10 and Proposisi 6.11 in this paper.
2. This research can be continued for solving inequality $A \otimes X \leq X \leq B \odot X$ and $X \leq G$, i. e the greatest solution where matrices $A, B, G \in IS^{n\times n}$ with a semiring IS is interval semiring.

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M – 23

Implementation Coloring Graph and Determination Waiting Time Using Welch-Powell Algorithm in Traffic Light Matraman

Mathematics

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***Abstract*—**Traffic jam often occurs while going to somewhere and interfere daily activities. Traffic jam happens because of the movement conflict at the intersection. Traffic is an important thing in controlling the intersection. The use of Welch -Powell algorithm to optimize the traffic light. The purpose of this research is to find out: (1) application of graph coloring on the intersection using the Welch -Powell algorithm to optimize the traffic light settings and, (2) finding out the calculation of waiting time results accord to coloring graph with the arrangements that have been adopted. The research method is including some steps that is data collection, data analysis and processing, manufacturing simulation, and conclusion. The data that used in this paper is primary data. Retrieval of data held in Matraman intersection, East Jakarta. The data is taken by the duration of the red light, yellow, and green when its turn on each the intersection .The obtained data then analyzed by several steps, that is (1) transforming the intersection into the form of graphs; (2) Coloring graph using Welch -Powell algorithm; and (3) calculating the duration of the settlement alternative traffic light and then calculate the level of effectiveness, subsequent manufacture of simulation. From this analyze we know that the results of the calculation is for the intersection. By this application, hope that can handle of the problem at the intersections traffic light and reduce traffic jam.

Keywords: *coloring graph, traffic light, welch-powell algorithm..*

I. INTRODUCTION

The operation of standard traffic lights which are currently deployed in many junctions, are based on predetermined timing schemes, which are fixed during the installation, and remain until further resetting. The timing is no more than a default setup to control what may be considered as normal traffic. Although every road junction by necessity requires different traffic light timing setup, many existing systems operate with an over simplified sequence. This has instigated various ideas and scenarios to solve the traffic problem.

Problem solving traffic light can be reviewed in the perspective of the graph, namely by representing the junction in the form of a graph. Vertex graph shows the direction of travel is allowed on the road X towards the Y, meanwhile the edge graph indicates the direction of travel that should not be done simultaneously. Subsequently finish with vertex coloring method using Welch - Powell algorithm.

This settlement will generate currents that can run simultaneously, but it also gained new alternative cycle duration. This new cycle duration will be compared with the cycle time of secondary data from the traffic light Matraman and is expected to be a solution for road users in order to speed up the waiting period when the red light is on.

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II. BASED THEORY

A. Graph

An undirected graph G is given by an ordered pair G= (V, E), where V is a set of vertices, |V|= n, and $E \subset V\ x\ V$- a set of edges, |E|= m. Two Vertices u, v ∈ V are called adjacent if they are connected by an edge: {u, v} ∈ E. An edge and a vertex on this edges incident. The degree deg (v) of a vertex v is measured as the number of edge incident to the vertex v: deg (v) = | {e∈: v ∈e}|.

B. Vertex Coloring

Let G be a graph without loops. A k-coloring of G is an assignment of k colors to the vertices of G in such a way that adjacent vertices are assigned different colors. If G has a k-coloring, then G is said to be k-colorable. The chromatic number of G, denoted by$\chi(G)$, is the smallest k for which G is k-colorable.

The color on a vertices can be represented by numbers or can also be represented directly using the color for example red, green, blue, yellow and others. The main problem in the coloring of the vertices is the search for solutions which use a minimum number of colors. The minimum number of colors used to color the graph is called the chromatic number

One algorithm that gives a good solution to a vertex-coloring problem is the *Welch•-Powell algorithm*. It may not always give the best solution, but it will usually perform better than just coloring the vertices without a plan will.

The Welch-Powell algorithm consists of the following steps:

1. Find the valence for each vertex.
2. List the vertices in order of descending valence (you can break ties any way you wish).
3. Color the first vertex in the list (the vertex with the highest valence) with color 1.
4. Go down the list and color every vertex not connected to the colored vertices above the same color. Then cross out all colored vertices in the list.
5. Repeat the process on the uncolored vertices with a new color - always working in descending order of valence until all the vertices have been colored.

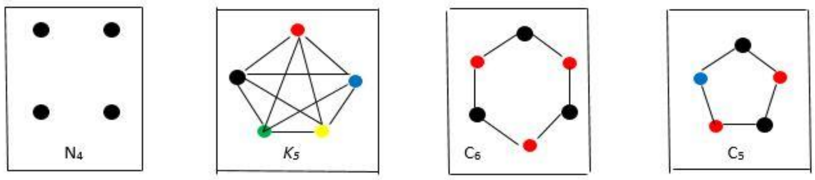

Figure 1. Example Chromatic Number

III. METHOD RESEARCH

To conduct the study must consider the procedures and steps that will be taken to initiate research that can be focused and performing well in terms of research reporting.

A. Method of Collecting Data

Research using several types of data collection methods, among others: the study of literature by collecting journals both national and international, dealing with Welch-Powell algorithm on graph coloring and traffic light settings, as well as field observations.

B. Method of Data Analysis

Qualitative methods used to identify and formulate the design principles Welch - Powell algorithm on graph coloring and setting the current total waiting time at traffic light intersections through qualitative descriptive analysis and content analysis. Literature study method is used to analyze matters concerning the concept of Welch - Powell algorithm on graph coloring and total waiting time at traffic light.

IV. RESULTS

A. Implementation of vertex coloring on traffic light Matraman

Traffic light available at a road intersection has several purposes, such as avoid obstacles because of differences in the flow path for the movement of vehicles, in order to facilitate pedestrians can cross safely, and reduce the rate of accidents caused by collisions due to differences in the flow path. But traffic light also has some problems that need to be resolved, one of the setting from duration of the red and green lights. This problem can be studied using the principle of vertex coloring settings.

For more details, here are the steps vertex coloring app on the traffic light at the intersection:

1. Transforming the crossroads along the current into the form of graphs. The vertex represents the current and the edge represents uncompatible currents, meaning that currents that should not be run simultaneously, which further vertices are interconnected.
2. Coloring each vertex in a graph using the Welch - Powell algorithm. In addition to knowing where the currents that could run concurrently, obtained also the amount of chromatic number that will be useful at a later stage.
3. Specifies an alternative to the settlement duration of green lights and red lights with a certain time cycle, how to divide one cycle consisting of a total duration of red and green light with chromatic number has been obtained from step 2 , the result of the division indicates the duration of the green light .

The following will describe one of case settlement arrangement that traffic light of Matraman intersection. Here is an illustration of the road at the intersection Matraman.

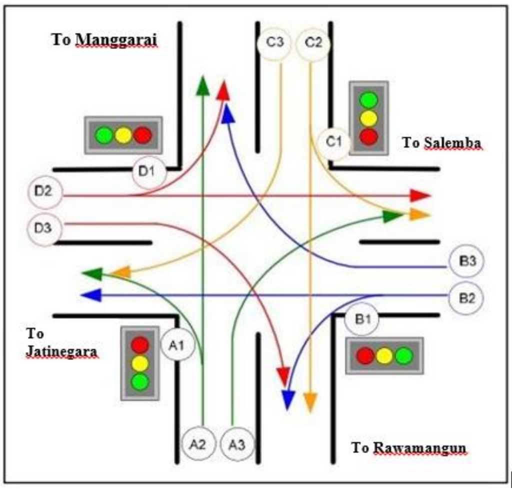

Figure 2. Illustration of Matraman traffic light

From the illustration Figure 2 by referring to the steps that have been described previously obtained results graph transformation as follows:

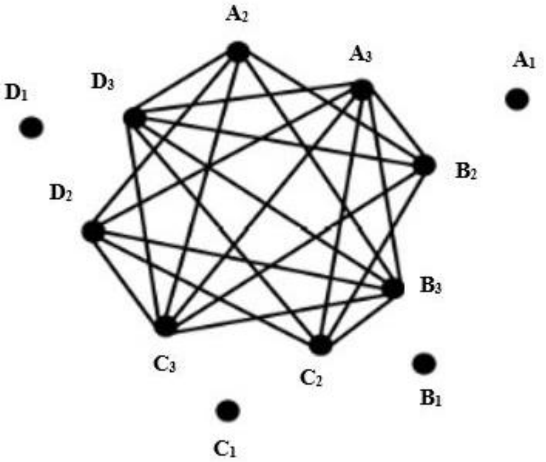

Figure 3. Graph of Matraman Traffic Light

From transformation of graph above, we know that the vertex A_1, B_1, C_1, D_1 are vertex foreign, it's mean that A_1, B_1, C_1, D_1 can simultaneously with other currents. So for the current stated by A_1, B_1, C_1, D_1

always apply the green light. Then, to the remaining vertex will be colored with Welch-Powell algorithm. Vertex coloring produced can be seen in Figure 4 below:

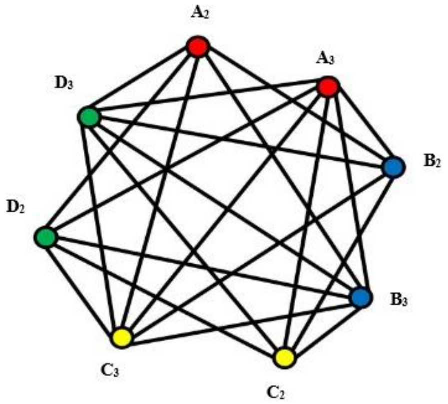

Figure 4. Result of Coloring Graph at Matraman Traffic Light

Obtained by the above coloring graph of chromatic number is 4 and the currents can be together as bellows:

Table 1. Vertex Colors Graph Matraman Traffic Light

Colors	Vertex
Red	A_2, A_3
Blue	B_2, B_3
Yellow	C_2, C_3
Green	D_2, D_3

From Table 1, can be formed partition of settings traffic light as bellows: 1) First partition, the current A_2 goes along with the current $A_{3,}$ 2) Second partition, the current B_2 goes along with the current B_3, 3) Third partition, the current C_2 goes along with the current C_3, 4) Fourth partition, the current D_2 goes along with the current $D_{3.}$

Table 2. Primary Data of Matraman Traffic Light

Intersections	Red	Yellow	Green	Total
Rawamangun	420	2	15	**437**
Jatinegara	244	2	85	**331**
Manggarai	320	2	42	**364**
Salemba	162	2	195	**359**
Total	**1146**	**8**	**337**	**1491**

Based on primary data obtained has found that intersection Matraman cycle time and the amount of chromatic number is 4. For alternative settlement of traffic lights can be seen below.

Table 3. Alternative settlement duration of traffic lights

Intersections	Traffic Light	Calculation	Results (second)
Rawamangun	Green Yellow Red	437/4 437-109.25-2	109.25 2 325.75
Jatinegara	Green Yellow Red	331/4 331-82.75-2	82.75 2 246.25
Manggarai	Green Yellow Red	364/4 364-91-2	91 2 268

Salemba	Green Yellow Red	359/4 359-89.75-2	89.75 2 267.25

from the above data, found that the results of new data as follows:

Table 4. New Data of Matraman Traffic Light

Intersections	**Red**	**Yellow**	**Green**
Rawamangun	325.75	2	109.25
Jatinegara	246.25	2	82.75
Manggarai	268	2	91
Salemba	267.25	2	89.75
Total	**1107.25**	**8**	**372.75**

Based on the duration of the red light and green light on traffic light Matraman. it can be seen that the new data the result of resolving cases Matraman traffic light settings by using welch-powell algorithm more effective than primary data. The following table is presented primary data and new data Matraman traffic light.

Table 4. Primary Data and New Data of Matraman Traffic Light

	Primary Data			**New Data**		
Intersections	**Red**	**Yellow**	**Green**	**Red**	**Yellow**	**Green**
Rawamangun	420	2	15	325.75	2	109.25
Jatinegara	244	2	85	246.25	2	82.75
Manggarai	320	2	42	268	2	91
Salemba	162	2	195	267.25	2	89.75
Total	**1146**	**8**	**337**	**1107.25**	**8**	**372.75**

The total duration of the green light from the primary data is 337 seconds, while the total duration of the vertex coloring green light was 372.75 seconds. The level of effectiveness that is

$$\frac{375.75 - 337}{337} x100\% = 11.49\%$$

The total duration of the red light from the primary data is 1146 seconds, while the total duration of the vertex coloring red light was 1107.25 seconds. The level of effectiveness that is

$$\frac{1146 - 1107.25}{1107.25} x100\% = 3.49\%$$

So for the case Matraman traffic light, green light duration will increase by 11.49% while the duration of the red light can be reduced by 3.49%

CONCLUSION

Based on the analysis and discussion can be drawn the conclusion that implementation of the intersection graph Welch - Powell algorithm for optimization of traffic light settings is by means (1) Transforming intersection along the current path to the form of graphs, (2) Coloring each vertex in the graph with Welch - Powell algorithm, (3) Determine the duration of the settlement alternative green light and red light, (4) Calculating the total duration of effectiveness level traffic light.

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M – 24

The Normality of Subgroups of n x n Matrices Over Integers Modulo Prime

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Abstract**—**This paper discusses about some properties of noncommutative finite group consists of n x n nonsingular matrices over integers modulo prime under matrix multiplication. Here we want to determined the normality of subgroups. Using Lagrange theorem, the subgroups of this noncommutative finite group is exist. We considered trivial and some nontrivial subgroups. The nontrivial subgroups which is considered here is matrices set with determinant one, upper triangular matrices and center of group. Start from 2 x 2 matrices, the set with only consist of identity element is normal subgroups. It can be happen because the noncommutative properties plays here. For 3 x 3 matrices, nontrivial subgroup is possible to be normal. In general, for group consist of n x n nonsingular matrices over integers modulo prime, not all of the subgroups is normal. Generally, subgroup consist only identity element of group is normal.

Keywords: *integers modulo prime, normality, subgroup*.

I. INTRODUCTION

On the previous paper, [7] got the order of group consists of n x n matrices over integers modulo prime numbers. In that paper, he give some open problems which is unsolved. On the other hand, as special case, [6] has discussed the normality of some subgroup from group of all nonsingular 3 x 3 matrices over integers modulo prime. Now, in this paper, by general order of matrices n x n and any prime number, we want to know the normality of some subgroups in noncommutative finite group. This is important because we work under one example of noncommutative groups. Usually, by commutative property of commutative group, we can easy to check the normality of the subgroup. But it can be different when the commutative property of group is dropped. Our motivation is to ensure that in noncommutative group it is possible to define normal subgroup. Hopefully, after the normality of subgroup is defined, we can extend the problem for this group using another concept in group theory such the quotient group, ring and etc.

In this paper, we start solving the normality from simple case for 2 x 2 matrices over integers modulo prime and continues to general form of n x n matrices. This is a good step to emphasize the existences of normal subgroup in general. By considered some subgroup of 2 x 2, we will get the pattern to define normal subgroup. After that, we expand for 3 x 3 matrices and n x n matrices. Note that the subgroup only considered for the set of matrices with determinant one, upper triangular matrice, and center of group. It is possible to check for any subgroup because in group, many various way to define th subgroup. We choose these subgroup because it is more simple than any other subgroup.

II. DISCUSSION

Let $Gl_{\mathrm{n}}\left(Z_p\right)=\left\{\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \middle| a_{11},\ldots,a_{nn}\in Z_p, \det\left(\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}\right)\neq 0\right\}$ is a set of n x n nonsingular matrices over integers modulo prime p. Under matrix multiplication this set form a group. For $n=2$ and $p=2$, we get

$$Gl_2(Z_2)=\left\{\begin{bmatrix} a & b \\ c & d\end{bmatrix}\middle| a,b,c,d\in Z_2, ad-bc\neq 0\right\}$$
$$=\left\{\begin{bmatrix} 1 & 0 \\ 0 & 1\end{bmatrix},\begin{bmatrix} 0 & 1 \\ 1 & 0\end{bmatrix},\begin{bmatrix} 1 & 0 \\ 1 & 1\end{bmatrix},\begin{bmatrix} 1 & 1 \\ 1 & 0\end{bmatrix},\begin{bmatrix} 1 & 1 \\ 0 & 1\end{bmatrix},\begin{bmatrix} 0 & 1 \\ 1 & 1\end{bmatrix}\right\}$$

is a noncommutative finite group under matrix multiplication where order $Gl_2(Z_2)$ is 6 ($o(Gl_2(Z_2))=6$) . Let $A=\begin{bmatrix} 1 & 0 \\ 0 & 1\end{bmatrix}$, $B=\begin{bmatrix} 0 & 1 \\ 1 & 0\end{bmatrix}$, $C=\begin{bmatrix} 1 & 0 \\ 1 & 1\end{bmatrix}$, $D=\begin{bmatrix} 1 & 1 \\ 1 & 0\end{bmatrix}$, $E=\begin{bmatrix} 1 & 1 \\ 0 & 1\end{bmatrix}$, $F=\begin{bmatrix} 0 & 1 \\ 1 & 1\end{bmatrix}$ where A is identity element, then we have tabel operation below

Table 1. Matrix operation under $Gl_2(Z_2)$

*	**A**	**B**	**C**	**D**	**E**	**F**
A	A	B	C	D	E	F
B	B	A	D	C	F	E
C	C	F	A	E	D	B
D	D	E	B	F	C	A
E	E	D	F	B	A	C
F	F	C	E	A	B	D

Now, let see the definition from [8]

Definition. If H is a subgroup of G, $a\in G$, then $Ha=\{ha \mid h\in H\}$ and $aH=\{ah \mid h\in H\}$. Ha and aH are called right coset and left coset, respectively, of H in G.

It is clear that $H_A=\{A\}$ and $H_{Gl_2(Z_2)}=Gl_2(Z_2)$ are trivial subgroups of $Gl_2(Z_2)$ which have $o(H_A)=1$ and $o\left(H_{Gl_2(Z_2)}\right)=o(Gl_2(Z_2))=6$, then $H_Aa=aH_A$ for all $a\in Gl_2(Z_2)$. But, there exist $B,C\in H_{Gl_2(Z_2)}=G$ such that $BC=D\in H_{Gl_2(Z_2)}a$ and $CB=F\in aH_{Gl_2(Z_2)}$ where $BC=D\neq F=CB$. So $H_{Gl_2(Z_2)}a=aH_{Gl_2(Z_2)}$ is not hold in general for $a\in Gl_2(Z_2)$. Before we continue, from [9] let consider Lagrange Theore below.

Lagrange's Theorem. If G is a finite group and H is a subgroup of G, then the order of H divides the order of G.

By this theorem, it is clear that $o(H_A)\Big|_{o(Gl_2(Z_2))}$ and $o\left(H_{Gl_2(Z_2)}\right)\Big|_{o(Gl_2(Z_2))}$. Furthermore, we can find another subgroup H of $Gl_2(Z_2)$ such that $o(H)\Big|_{o(Gl_2(Z_2))}$. In our case, $o(H)$ can be 2 or 3. From the table 1, we can construct $H_1=\{A,B\}$ is a subgroup of $Gl_2(Z_2)$ where $o(H)_1=2$. Now we check $H_1a=aH_1$ for all $a\in Gl_2(Z_2)$. Again, we get in H_1a for $a=C\in Gl_2(Z_2)$ and $B\in H_1$, $H_1a\neq aH_1$. And for subgroups $H_2=\{A,C\}$, $H_3=\{A,E\}$, $H_4=\{A,D,F\}$ it can be shown that $H_2a\neq aH_2$, $H_3a\neq aH_3$, and $H_4a\neq aH_4$ for some $a\in Gl_2(Z_2)$. So far, in $Gl_2(Z_2)$ we only have one subgroup such that right coset is similar with left coset. Furthermore, by definition below we will define normal subgroup in [9].

Definition. $N \lhd G$ (N is normal subgroup in G) if and only if every left coset of N in is a right coset in G.

By this definition, we can conclude that the only normal subgroup in $Gl_2(Z_2)$ is $H_A = \{A\}$. If we classify all of subgroups of $Gl_2(Z_2)$, we can characterize become subgroup with determinant one is $H_A = \{A\}$, upper triangular matrix is $H_3 = \{A, E\}$. For any group G, let define center of group by $Z(G) = \{z \in Gx | zx = xz \text{ for all } x \in G\}$. It is clear for $Z(Gl_2(Z_2)) = \{E\}$. So far, we already check for $n = 2$, $p = 2$, the only normal subgroup is trivial subgroup consist only identity element.

From [5], we get order of $Gl_2(Z_p)$ is $p^4 - \left((2p-1)^2 + (p-1)^3\right)$. The problem is not easy if we want to find some normal subgroup for any prime p in $Gl_2(Z_p)$. Fortunately, by Lagrange's Theorem, at least one of subgroup in $Gl_2(Z_p)$ i.e trivial subgroups consist only identity element. How about group consist of 3 x 3 matrices over integers modulo prime? By [6], we get the order of $Gl_3(Z_p)$, is $(p-1)^3 p^3 (p+1)\left(p^2 + p + 1\right)$. From this, if we define $H = \left\{ \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \middle| a_{ij} \in Z_p, \left| \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \right| = 1 \right\}$, then $H \lhd G$. Moreover, [6] got $Z(Gl_3(Z_p)) = \left\{ z \in Gl_3(Z_p) \middle| zx = xz \text{ for all } x \in Gl_3(Z_p) \right\} \lhd Gl_3(Z_p)$. In addition, if we consider all of diagonal matrices in $Gl_3(Z_p)$, in set notation $D_3(Z_p) = \left\{ \begin{bmatrix} s & 0 & 0 \\ 0 & t & 0 \\ 0 & 0 & u \end{bmatrix} \middle| s, t, u \in Z_p \right\}$ is not normal in $Gl_3(Z_p)$ except if $p = 2$. We can say that $D_3(Z_p)$ is special upper triangular matrices in $Gl_3(Z_p)$. So we can get another normal subgroup which is nontrivial subgroup.

Let get back to $Gl_n(Z_p)$, and define $H_1(Gl_n(Z_p))$ as a set of all nonsingular n x n matrices over Z_p whose determinant is one. It can be easily shown that $H_1(Gl_n(Z_p))$ is subgroup of $Gl_n(Z_p)$. Let $A, B \in H_1(Gl_n(Z_p))$, then $A \equiv B \bmod H_1(Gl_n(Z_p))$ if and only if $\left|AB^{-1}\right| = 1$ if only if $|A| = |B|$. Then, $H_1(Gl_n(Z_p)) \lhd Gl_n(Z_p)$ for if $A \in Gl_n(Z_p)$ and $K \in H_1(Gl_n(Z_p))$ then $\left|AKA^{-1}\right| = 1$ and hence $AKA^{-1} \in H_1(Gl_n(Z_p))$ which shows that $AH_1(Gl_n(Z_p))A^{-1} \subseteq H_1(Gl_n(Z_p))$.

Let define $Gl_{\mathrm{n},u}\left(Z_p\right)=\left\{\left.\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ 0 & a_{22} & \cdots & a_{2n} \\ 0 & 0 & \ddots & \vdots \\ 0 & 0 & \cdots & a_{nn} \end{bmatrix}\right\| a_{11},\ldots,a_{nn}\in Z_p\right\}$ as a set of all upper triangular matrices in $Gl_n\left(Z_p\right)$. Then for $A,B\in Gl_{\mathrm{n},u}\left(Z_p\right)$, $AB\in Gl_{\mathrm{n},u}\left(Z_p\right)$, assosiative properties hold and $I_n\in Gl_{\mathrm{n},u}\left(Z_p\right)$. It is clear that $a_{ii}, i=1,2,\cdots,n$ is all not zero so that every element in $Gl_{n,u}\left(Z_p\right)$ is invertible. So form a subgroup of $Gl_n\left(Z_p\right)$. For all $X\in Gl_n\left(Z_p\right)$, $A\in Gl_{\mathrm{n},u}\left(Z_p\right)$, then $XAX^{-1}\in Gl_{\mathrm{n},u}\left(Z_p\right)$. This is obvious from [1] that the multiplication of any matrix with upper triangular matrix is upper triangular matrix too. But in general, we cannot say $Gl_{n,u}\left(Z_p\right)\lhd Gl_n\left(Z_p\right)$ because there exist $X\in Gl_n\left(Z_p\right)$ and $A\in Gl_{\mathrm{n},u}\left(Z_p\right)$ such that $XGl_{\mathrm{n},u}\left(Z_p\right)\neq Gl_{\mathrm{n},u}\left(Z_p\right)X$. Here noncommutative properties of matrix set plays. On the other hand, if we define $Z\left(Gl_n\left(Z_p\right)\right)=\left\{z\in Gl_n\left(Z_p\right)\middle| zx=xz \text{ for all } \mathrm{x}\in Gl_n\left(Z_p\right)\right\}$, by our concept, center of group is always normal subgroup. Some problem wthat is not solved is how to define order of $H_1\left(Gl_n\left(Z_p\right)\right)$, $Gl_{n,u}\left(Z_p\right)$, and $Z\left(Gl_n\left(Z_p\right)\right)$.

III. Conclusion

Basicly, noncommutative finite group is interesting to learned. The normality of subgroup of group consist of n x n nonsingular matrices over integers modulo prime cannot determine directly. It is depends on the number of integer n and prime number p. The problem rise up when we want to know the order of these subgroups. Our sugestion is determine the order at the first then we check the normality of subgroup. After that it is possible to define any group such that quotient of group.

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M – 25

Adjacency Metric Dimension of Graphs with Pendant Points

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Abstract— Let G =(V(G),E(G)) be any graph of order n = |V(G)| and measure k = |$E(G)$|, W = { w_1, w_2, ..., w_k} be an order set of vertices and y a vertex in G. The adjacency representation of y with respect to W is the ordered k-tuple $r(y|W) = (d(y, w_1), d(y, w_2), ..., d(y, w_k))$, where $d(u, v)$ represents the adjacency distance between the vertices u and v. The set W is called an adjacency resolving set of G if every two vertices u and v in G satisfy $r(u|W) \neq r(v|W)$. A minimum adjacency resolving set for G is an adjacency metric basis of G. Adjacency metric dimension for G, $\dim_A(G)$, is the cardinality of vertices in an adjacency metric basis for G. In this paper, we study and determine the *adjacency metric dimension* of graphs with pendant points. A pendant point is every vertex of an empty graph, $H=\overline{K_m} \cong mK_1, m \geq 1$ that joining two end-vertices s_i, s_h of edge $e_j = s_is_h$ of G in $G\Diamond H.$ An Edge-corona graph $G\Diamond H$ is a graph formed by taking G and k = |$E(G)$| copies of H then joining two end-vertices s_i, s_h of edge $e_j = s_is_h$ of G to every vertex in the j^{th}-copy of H. So, if we choose an emphty graph, $\overline{K_m} \cong mK_1, m \geq 1$ as H of an edge-corona graph $G\Diamond H,$ we obtain a graph with pendant points.

Keywords: *adjacency distance, adjacency resolving set, adjacency metric dimension, edge-corona graph, pendant point*

I. INTRODUCTION

This section presents about some definitions and known results that are using for prove the main theorem of this research. We begin with, G = (V(G),E(G)) is a simple, finite and connected graph with a set of vertices V(G) and a set of edges E(G), of cardinality n and k, respectively. Two adjacent vertices u and v will be write $u \sim v$ and two vertex u and v that is not adjacent with $u \not\sim v.$ The distance between two vertices u and v in G, $d(u,v)$ is the lenght of shortest path joining u and v. The adjacency distance between u and v denoted by $d_A(u,v)$, and defines by [4], $d_A(u, v_i) = \begin{cases} 0 & if\ u = v_i, \\ 1 & if\ u \sim v_i, \\ 2 & if\ u \not\sim v_i. \end{cases}$ Let $W = \{w_1, w_2, ..., w_k) \subseteq V(G)$ be an order set of vertices and y a vertex in G. The adjacency representation of y with respect to W is the ordered k-tuple $r_A(y|W) = (d_A(y, w_1), d_A(y, w_2), ..., d_A(y, w_k))$. W is called adjacency resolving set of G, if a pair of distinct vertices in G have different adjacency representation.. A minimum adjacency resolving set for G is an adjacency metric basis of G. Adjacency metric dimension for G, $\dim_A(G)$, is the cardinality of vertices in an adjacency metric basis for G.

Farthest before concept about adjacency metric dimension has introduced by Jannesari and Omoomi [4], Harary and Melter [2] have been introduced about resolving set in 1976 and independently, Slater [5] introduce this concept in 1975. This concept is a basic concept that must be known when a research results metric dimension of graphs. To prove that set W is resolving set of a graph G, we only present that every vertex in $V(G)\backslash W$ has distinct representation, because vertex y in W is unix vertex with $d(y, y) = 0$.

The following results have proved by Jannesari and Omoomi that used in this reasearch.

Proposition 1.1. [4] *If a graph G is connected, then* $\dim_A(G) \geq \dim(G)$.
Proposition 1.2. [4] *If G is a graph of order n, then*

(i) $\dim_A(G) = 1$ *if and only if* $G = \{P_1, P_2, P_3, \overline{P_2}, \overline{P_3}\}$.

(ii) $\dim_A(G) = n-1$ *if and only if* $G = K_n$ *or* $G = \overline{K_n}$.

In this paper, as G, we use P_n, C_n, K_n and $K_{1,n}$. Motivated by results in [1] and [3], we study and determine the adjacency metric dimension of graphs with pendant points (edge-corona of graphs $G \Diamond H$ when $H = K_1$ and $H = mK_1$ for $m \geq 2$). $G \Diamond H$ is a graph formed by taking G and $k = |E(G)|$ copies of H then joining two end-vertices s_i, s_h of edge $e_j = s_i s_h$ of G to every vertex in the j^{th}-copy of H [6].

II. RESULTS

In the following, we present some useful results on the adjacency metric dimension of graphs with pendant points.

Theorem 2.1. *Let G be a connected graph of order* $n \geq 2$ *and measure* $k \geq 2$. *Then* $\dim_A(G \Diamond K_1) = 2$ *if and only if* $G = \{P_2, P_3, C_3\}$.

Proof. 1). If $G = P_2$ then $G \Diamond K_1 \cong K_3$, so by Proposition 1.2.(ii) we obtain $\dim_A(P_2 \Diamond K_1) = 2$. If $G = P_3$ then $G \Diamond K_1 \cong P_3 \Diamond K_1$. Because $P_3 \Diamond K_1 \notin \{P_1, P_2, P_3, \overline{P_2}, \overline{P_3}\}$, according to Preposition 1.2 (i). $\dim_A(G \Diamond K_1) \geq 2.$ Let $V(P_3) = \{x_1, x_2, x_3\}$ is set vertices of $P_3 \Diamond K_1$ and a_j is a pendant point of $e_j = x_i x_{i+1} \in E(P_3), 1 \leq i = j \leq 2.$ Let $B = \{a_1, a_2\} \subseteq V(P_3 \Diamond K_1).$ Adjacency representations all of vertices from $V(G \Diamond K_1) \backslash B$ are $r_A(x_1|B) = (1,2)$, $r_A(x_2|B) = (1,1)$ and $(x_3|B) = (2,1)$. These adjacency representations are unix. So, $\dim_A(G \Diamond K_1) \leq 2.$ Moreover, if $G = C_3$ then by Preposition 1.2 (i)., we obtain $\dim_A(C_3 \Diamond K_1) \geq 2.$ Let $V(C_3) = \{x_1 = x_4, x_2, x_3\}$ and a_j is a pendant point of edge $e_j = x_i x_{i+1} \in E(C_3),\ 1 \leq i = j \leq 3.$ Let $B = \{a_1, a_2\} \subseteq V(C_3 \Diamond K_1).$
Adjacency representations all of vertices $V(C_3 \Diamond K_1) \backslash B$ are $r_A(x_1|B) = (1,2)$, $r_A(x_2|B) = (1,1)$ and $(x_3|B) = (2,1)$ and $(a_3|B) = (2,2)$. All of these adjacency representations are distinct, as consequence $\dim(C_3 \Diamond K_1) \leq 2.$

2). Now, we will show that if $\dim_A(G \Diamond K_1) = 2.$ then $G = \{P_2, P_3, K_3\}$.

Let $G \Diamond K_1$ be a graph with $\dim_A(G \Diamond K_1) = 2.$ According to definition of edge-corona graph [6], G must have at least an edge, so G is P_2. If G be a graph of order 3 and connected, then certainly G is P_3 or K_3.☐

Theorem 2.2. *Let G be a connected graph of order* $n \geq 4$ *and measure* $k \geq 1$. *Then*

$$\dim_A(G \Diamond K_1) = \begin{cases} k & ,if\ G = K_{1,n}, P_4\ and\ P_5 \\ k-1 & , \qquad otherwise \end{cases}$$

Proof. 1). (A) For $G = K_{1,n}$, let c is a vertex in $V(K_{1,n})$ with degree $|V(K_{1,n})| - 1$, x_i is i^{th}–vertex of $V(K_{1,n}) \backslash \{c\}$ and $a_j,\ 1 \leq j \leq k = n-1$ is a pendant point of edge $e_j = cx_j \in E(K_{1,n}).$

(a).Firstly, we show that $\dim_A(K_{1,n} \Diamond K_1) \leq k.$ Let $W = \{a_j \mid 1 \leq j \leq k = n-1\} \subseteq V(K_{1,n} \Diamond K_1) \backslash \{c\}.$
Representations of all vertices from $V(K_{1,n} \Diamond K_1) \backslash B$ are

$r_A(c\mid B)=(\underbrace{1,1,...,1}_{k\ term})$ and $r_A(x_i\mid B)=(\underbrace{2,...,2,\ \underset{i^{th}-term}{1}\ ,2,...,2}_{k\ term}).$

All of this adjacency representations are distict.

(b). Now, we present that $\dim_A(K_{1,n}\Diamond K_1)\geq k.$ Assume that adjacency basis of $K_{1,n}\Diamond K_1$ is B with $|B|<k$. Then, there exist at least two distinct vertices $u,v\in V(K_{1,n}\Diamond K_1)\setminus(B\bigcup\{c\})$ such that adjacency representation of a vertex u is the same as adjacency representation of a vertex v, that is $r_A(u\mid B)=(\underbrace{2,2,...,2}_{k\ term})=r_A(v\mid B).$

(B). For $G = P_4$ and P_5, we will proof that (i). $\dim_A(P_4\Diamond K_1) = 3$ and (ii). $\dim_A(P_5\Diamond K_1) = 4$ as follows: Let $V(P_4) = \{x_i\mid 1\leq i\leq 4\}$, $V(P_5) = \{x_i\mid 1\leq i\leq 5\}$, a_j is a pendant point of edge $e_j = x_ix_{i+1}\in E(P_4),\ 1\leq i = j\leq 3$ and b_j is a pendant point of edge $e_j = x_ix_{i+1}\in E(P_5),$ $1\leq i = j\leq 4.$

(i). According to Theorem 2.1, $\dim_A(P_4\Diamond K_1)\geq 3$ and $\dim_A(P_5\Diamond K_1)\geq 3$, but any set of three elemen is not resolving set of $P_5\Diamond K_1$. Because a basis element of $P_5\Diamond K_1$ is not element of $V(P_5)$ then without lost of generality take any three distinct vertices $b_1,b_2,b_3\in V(P_5\Diamond K_1)$ and set $W = \{b_1,b_2,b_3\}.$ Then Adjacency representations all of vertices in $V(P_5\Diamond K_1)\setminus W = \{a_4,x_i\mid 1\leq i\leq 5\}$ with respect to W are

$$r_A(x_1\mid W)=(1,2,2),\ r_A(x_2\mid W)=(1,2,1),\ r_A(x_3\mid W)=(2,1,1),$$
$$r_A(x_4\mid W)=(2,1,2),\ r_A(x_5\mid W)=(2,2,2),\ \text{and}\ r_A(a_4\mid W)=(2,2,2).$$

Because $r_A(x_5\mid W)=r_A(a_4\mid W)$ then W is not resolving set of $P_5\Diamond K_1$. So $\dim_A(P_5\Diamond K_1)\geq 4.$

(ii). Now, we present that $\dim_A(P_4\Diamond K_1)\leq 3$ and $\dim_A(P_5\Diamond K_1)\leq 4.$ Let $W_1 = \{a_1,a_2,a_3\}$ and $W_2 = \{b_1,b_2,b_3,b_4\}.$ Adjacency representations of all vertices from $V(P_4\Diamond K_1)-W_1$ with respect to W_1 and $V(P_5\Diamond K_1)-W_5$ with respect to W_2 are

$$r_A(x_1\mid W)=(1,2,2),\ r_A(x_2\mid W)=(1,1,2),\ r_A(x_3\mid W)=(2,1,1),\ r_A(x_1\mid W)=(2,2,1),$$

and

$$r_A(x_1\mid W)=(1,2,2,2),\ r_A(x_2\mid W)=(1,2,1,2),\ r_A(x_3\mid W)=(2,1,1,2),$$
$$r_A(x_4\mid W)=(2,1,2,1),\ r_A(x_5\mid W)=(2,2,2,1).$$

brespectively. All of these adjacency representations are distinct, so $\dim(P_4\Diamond K_1)\leq 3$ and $\dim(P_5\Diamond K_1)\leq 4.$

2) I. For $G = C_n$, here we show that $\dim(C_n\Diamond K_1)=k-1.$ (a) Let $V(C_n)=\{x_1=x_{n+1},x_2,...,x_n\}$ and $E(C_n)=\{x_ix_{i+1}\mid 1\leq i\leq n\}.$ Then $C_n\Diamond K_1$ have $V(C_n\Diamond K_1)=V(C_n)\bigcup\ \{a_i\mid 1\leq i\leq k\},$ $E(C_n\Diamond K_1)=\ E(C_n)\bigcup\{x_ia_i\mid 1\leq i\leq n=k\}\bigcup\{x_{i+1}a_i\mid 1\leq i\leq n=k\}.$ Let $B = \{a_i\mid 1\leq i\leq$ $\leq k-1\}\subseteq V(C_n\Diamond K_1).$ Adjacency representations of vertices from $V(C_n\Diamond K_1)\setminus B$ with respect to B are

$$r_A(a_k\mid B)=(\underbrace{2,2,...,2}_{k-1\ term}),\ r_A(x_1\mid B)=(\underbrace{1,2,...,2}_{k\ term}),\ r_A(x_n\mid B)=(\underbrace{2,2,...,1}_{k\ term}),$$
$$r_A(x_i\mid B)=(\underbrace{2,...,2,\ \underset{i^{th}-term}{1}\ \ \underset{(i+1)^{th}\ term}{1}\ ,2,...,2}_{k\ term}),\ \ 2\leq i\leq k-3$$

All of these adjacency representation are distinct, so $\dim_A(C_n\Diamond K_1)\leq k-1.$

(b). Now, we present that $\dim_A(C_n\Diamond K_1)\geq k-1$. Assume that adjacency basis of $C_n\Diamond K_1$ is $B\subset A=\bigcup_{i=1}^{k}\{a_i\}$, with $|B|<k-1$. Then, there exist at least two distinct vertices $a_i, a_j \in A\setminus B$ such that adjacency representation of vertex a_i is the same as adjacency representation of vertex a_j, that is $r_A(a_i\mid B)=(2,2,...,2)=r_A(a_j\mid B)$. It is a contradiction.

II. For $G = K_n$, here we will show that $\dim(K_n\Diamond K_1)=k-1$. (a) Let a_j is a pendant point of edge e_j, $V(K_n)=\{y_1,y_2,...,y_n\}$ and $E(K_n)=\{e_j=y_iy_h \mid 1\leq i<h\leq n\}$. Then $K_n\Diamond K_1$ has $V(K_n\Diamond K_1)=V(K_n)\bigcup\{a_j\mid 1\leq j\leq k\}$, $E(K_n\Diamond K_1) = E(K_n) \bigcup \{y_ia_j \mid 1\leq i<h\leq n\} \bigcup\{y_ha_j \mid 1\leq h<i\leq n\}$. Let $B=\{a_j\mid 1\leq j\leq k-1\}\subseteq V(K_n\Diamond K_1)$. Adjacency representations of all vertices from $V(K_n\Diamond K_1)\setminus B$ with respect to B are

$$r_A(a_k\mid B)=(\underbrace{2,2,...,2}_{k-1\ term}),\ r_A(x_1\mid B)=(\underbrace{1,2,...,2}_{k-1\ term}),\ r_A(x_n\mid B)=(\underbrace{2,2,...,1}_{k-1\ term}),$$

$$r_A(x_i\mid B)=(\underbrace{2,...,2,\ \underbrace{1}_{i^{th}-term}\ \underbrace{1}_{(i+1)^{th}-term},2,...,2}_{k-1\ term}),\quad 2\leq i\leq k-3$$

All of these adjacency representations are distinct, so $\dim_A(K_n\Diamond K_1)\leq k-1$.

(b). Now, we present that $\dim_A(K_n\Diamond K_1)\geq k-1$. Let $B\subset A=\bigcup_{j=1}^{k}\{a_j\}$, with $|B|<k-1$ be an adjacency resolving set for $K_n\Diamond K_1$. Then, there are at least two distinct vertices that is $a_s, a_t\in A\setminus B$ such that adjacency representation of vertex a_s is the same as adjacency representation of vertex a_t, that is $r_A(a_s\mid B)=(\underbrace{2,2,...,2}_{k-1\ term})=r_A(a_t\mid B)$. It is a contradiction.

III. For $G=P_n$, $n\geq 6$, and $k\geq 5$. Let $V(P_n)=\{x_i\mid 1\leq i\leq n\}$ and $E(P_n)=\{e_i=x_ix_{i+1}\mid 1\leq i\leq n-1\}$ be the set of vertices and the set of edges of P_n respectively. The pendant point of e_i be denote by a_j, $1\leq j\leq k$. There exist two cases:

Case1: When, $n=2m+1$, for $m\in N$. We will show that $W=\{a_1,a_k,a_2,a_{k-1},...,a_{(k/2)+2},a_{(k/2)}\}$ is an adjacency resolving set for $P_n\Diamond K_1$. Adjacency representations of all vertices from $V(P_n\Diamond K_1)$ \W are

$$r_A(a_{(k/2)+1}\mid W)=(\underbrace{2,2,...,2}_{k-1\ term}),$$

$$r_A(x_1\mid W)=(\underbrace{1,2,2,...,2}_{k-1\ term}),$$

$$r_A(x_2\mid W)=(\underbrace{1,2,1,2,2,2,...,2}_{k-1\ term}),$$

$$r_A(x_3\mid W)=(\underbrace{2,2,1,2,1,2,2,2,...,2}_{k-1\ term}),$$

$$\vdots$$

$$r_A(x_m\mid W)=(\underbrace{2,2,...,2,1,2,1}_{k-1\ term}),$$

$$r_A(x_{m+1} \mid W) = (\underbrace{2,2,...,2,2,2,1}_{k-1\ term}),$$
$$r_A(x_{m+2} \mid W) = (\underbrace{2,2,...,2,2,1,2}_{k-1\ term}),$$
$$r_A(x_{m+3} \mid W) = (\underbrace{2,2,...,2,2,1,2,1,2}_{k-1\ term}),$$
$$\vdots$$
$$r_A(x_{n-1} \mid W) = (\underbrace{2,1,2,1,2,2,...,2}_{k-1\ term}),$$
$$r_A(x_n \mid W) = (\underbrace{2,1,2,2,2,...,2}_{k-1\ term}),$$

All of these adjacency representations are different. W is an adjacency resolving set of $P_n \Diamond K_1$ with minimum cardinality, such that W is an adjacency basis of $P_n \Diamond K_1$. Because, assume that $|W| < k$-1. Then, there are two vertices of $P_n \Diamond K_1$ with the same adjacency representation , that is $a_{(k/2)}$ and $a_{(k/2)+1}$ with $r_A(a_{(k/2)}) = (2,2,...,2) = r_A(a_{(k/2)+1})$. Therefore $\dim_A(P_n \Diamond K_1) = k-1$.

Case 2: When, $n = 2m$, for $m \in N$. We will show that $B = \{a_1, a_k, a_2, a_{k-1},..., a_{(k/2)-1}, a_{(k/2)+1}\}$ is an adjacency resolving set of $P_n \Diamond K_1$. Adjacency representations of all vertices from $V(P_n \Diamond K_1) \setminus B$ are

$$r_A(a_{((k-1)/2)+1} \mid B) = (\underbrace{2,2,...,2}_{k-1\ term}),$$
$$r_A(x_1 \mid B) = (\underbrace{1,2,2,...,2}_{k-1\ term}),$$
$$r_A(x_2 \mid B) = (\underbrace{1,2,1,2,2,2,...,2}_{k-1\ term}),$$
$$r_A(x_3 \mid B) = (\underbrace{2,2,1,2,1,2,2,2,...,2}_{k-1\ term}),$$
$$\vdots$$
$$r_A(x_m \mid B) = (\underbrace{2,2,...,2,2,1,2}_{k-1\ term}),$$
$$r_A(x_{m+1} \mid B) = (\underbrace{2,2,...,2,2,2,1}_{k-1\ term}),$$
$$r_A(x_{m+2} \mid B) = (\underbrace{2,2,...,2,2,1,2,1}_{k-1\ term}),$$
$$r_A(x_{m+3} \mid B) = (\underbrace{2,2,...,2,2,1,2,1,2,2}_{k-1\ term}),$$
$$\vdots$$
$$r_A(x_{n-1} \mid B) = (\underbrace{2,1,2,1,2,2,...,2}_{k-1\ term}),$$
$$r_A(x_n \mid B) = (\underbrace{2,1,2,2,2,...,2}_{k-1\ term}).$$

These adjacency representations are distinct. Further, W is a basis adjacency for $P_n \lozenge K_1$. If it is not, assume that cardinality of B, $|B| < k$-1. Then, there are a pair vertices of $P_n \lozenge K_1$ that is $a_{((k-1)/2)}$ and $a_{((k-1)/2)+1}$ with $r_A(a_{((k-1)/2)}) = (2,2,...,2) = r_A(a_{((k-1)/2)+1})$, that cause B is not resolving set for $P_n \lozenge K_1$, a contradicition. Therefore $\dim_A(P_n \lozenge K_1) = k-1$. □

Theorem 2.3. *Let G be a connected graph of order n and measure k. If* $\overline{K_m}$ = mK_1 *is complement of complete graph with* $m \geq 2$ *then* $\dim_A(G \lozenge mK_1) = mk-1$.

Proof. Let x_{1j}, x_{2j} are 1^{th}-endvertex and 2^{nd}-endvertex of j^{th}-edge $e_j = x_{1j}x_{2j} \in E(G)$, and a_j, $1 \leq j \leq k$ is a pendant point of edge $e_j = x_{1j}x_{2j} \in E(G)$. Let $d(u, v)$ is an adjacency distance between two vertices u and v in $G \lozenge K_1$. For every $j \in \{1,2,...,k\}$, every pair.of vertices a, $b \in (\overline{K_m})_j$ satisfy $d_A(a,x) = d_A(b,x)$ for all $x \in V(G \lozenge mK_1) - \{a,b\}$. Moreover, ($\overline{K_m}$) is an adjacency distance similar equivalence class in a connected graph $G \lozenge mK_1$. By observation 1., we obtain $\dim_A(G \lozenge mK_1) \geq mk-1$. Next, we will show that $\dim_A(G \lozenge mK_1) \leq mk-1$. Without lost of generality, choose B = { a_{11}, a_{21}, ..., a_{m1}, a_{12}, a_{22}, ..., a_{m2}, ..., a_{1k}, a_{2k}, ..., $a_{(m-1)k}$} be an adjacency basis of $G \lozenge mK_1$. Adjacency representation of the other vertices in $G \lozenge mK_1$ are

$$r_A(a_{mk}|B) = (\underbrace{2,2,...,2}_{mk-1\ term}),$$

$$r_A(x_{11}|B) = (\underbrace{1,1,...,1}_{m\ term}, \underbrace{2,2,...,2}_{m(k-1)\ term})$$

$$r_A(x_{21}|B) = (\underbrace{1,1,...,1}_{m\, term}, \underbrace{1,1,...,1}_{m\, term}, \underbrace{2,2,...,2}_{m(k-2)})$$

$$r_A(x_{2k}|B) = (\underbrace{2,2,...,2}_{m(k-1)\ term}, \underbrace{1,1,...,1}_{m\, term})$$

$$r_A(x_{1j}|B) = (2,2,...,2, \underbrace{1,1,...,1}_{m\ (j-1)^{th}-term} \underbrace{1,1,...,1}_{m\ (j^{th})-term}, 2,2,...,2), \quad 2 \leq j \leq k. \ r_A(x_{2j}|B) =$$

$$(2,2,...,2, \underbrace{2,2,...,2}_{m\ (j-1)^{th}-term} \underbrace{1,1,...,1}_{m\ (j^{th})-term}, 2,2,...,2), \quad 2 \leq j \leq k.$$

All of these adjacency representations of all vertices $x \in V(G)$ with respect to B are distinct. Then, B is an adjacency resolving set for $G \lozenge mK_1$. So, $\dim_A(G \lozenge mK_1) \leq mk-1$. □

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Parameter Estimation Smith Model of Max-Stable Process Spatial Extreme Value

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Abstract—The unpredictable extreme rainfall can cause flood. Prediction to this extreme rainfall needs to do, so that the efforts to cope flood can be effective. One of the methods that can predict the extreme rainfall is the Spatial Extreme Value (SEV) with the Max-Stable Process (MSP) approach. One of the important purpose in the Spatial Extreme Value (SEV) is the calculation of return level (the predicted extreme value). The calculation of return level depends on parameter estimation in that method. This research disscusses about parameter estimation of the Spatial Extreme Value (SEV) Max-Stable Process especially Smith Model. Parameter estimation is done by using the methods of Maximum Composite Likelihood Estimation (MCLE) dan Maximum Pairwise Likelihood Estimation (MPLE). If the result of estimation using this method is not closed form, it must be continued by using numerical iteration method. The iteration method used in this research is the Broyden-Fletcher Goldfarb-Shanno (BFGS) Quasi Newton, that fastly to be convergence than other methods. The result of parameter estimation will be applied in the rainfall data of Ngawi Regency which is the Regency with the largest rice production in East Java Province (the provice with the largest rice farm in Indonesia).

Keywords : *BFGS Quasi Newton, Smith Model, Max-Stable Process, likelihood estimation, precipitation extreme, return level.*

I. INTRODUCTION

Lamongan Regency is a regency which has the largest rice farm in East Java. Amongan Regency is also included the area which is often attacked by flood. The unpredictable extreme rainfallis the cause of this disaster. Based on the reason, the extreme rainfall prediction needs to be done in Lamongan Regency.

One method to predict extreme rainfall value is *Spatial Extreme Value* (SEV). SEV Method handles the case of extreme happening (like the extreme raifall) by considering dependency between happening in a region and another region[1]. The value of these extreme happenings are counted in a distribution *Generalized Extreme Value* (GEV), it is distribution which considering the shape of tail of data distribution [2]. SEV can be approached by *Max-Stable Process* (MSP) [3]. MSP uses *Block Maxima* (BM) method in choosingthe extreme values of all cases data.

The main goal of SEV is to acquire *return level (prediction value of extreme happening)*. *Return level*can be acquired when a number of parameter estimators are known. Parameter estimation method which is mostly proposed by the previous researchers are *Maximum Composite Likelihood Estimation* (MCLE) and *Maximum PairwiseLikelihood Estimation* (MPLE) by [4], [5], [6].

This research estimates parameter toward *Max-Stable Process* (MSP), which involves one of its model, it is *Smith*Model. If the result of parameter estimation is not *close form,* so that it must be continued by using numerical iteration method, in research, it will be used iteration method of *Broyden-Fletcher Goldfarb-Shanno* (BFGS) *Quasi Newto,* by considering that iteration in this method is faster to reach convergency than the other methods [7].

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II. REFERENCE OVERVIEW

A. Extreme Value Theory (EVT)

Extreme Value Theory (EVT) is a theory which studies about the probability of extreme happenings by focusing on the tail behavior of a distribution [2]. The tail behavior which declines slowly (the fat tail shape) indicates the existance of probability of extreme happenings. The fatter the tail of distribution is, the bigger the brobability of extreme value to appear. [8] and [9] explains that there are two methods of defining extreme value. They are BM and*Peak Over Threshold* (POT).

Extreme Value theory involves a distribution for generalizing extreme data into distribution of GEV[10]. X~GEV(μ, α, ξ) has the form of *Probability Density Function* (PDF)

$$f(X;\mu,\sigma,\xi) = \begin{cases} \frac{1}{\sigma}\left[1+\xi\frac{(X-\mu)}{\sigma}\right]^{-\frac{1}{\xi}-1}\exp\left(-\left[1+\xi\frac{(X-\mu)}{\sigma}\right]^{-1/\xi}\right), & \xi \neq 0 \\ \frac{1}{\sigma}\exp\left(-\frac{X-\mu}{\sigma}\right)\exp\left(-\exp\left[-\frac{(X-\mu)}{\sigma}\right]\right), & \xi = 0 \end{cases} \quad (2)$$

X is variable of observation, μ is parameter of location, σ is parameter of scale, $\sigma > 0$, and ξ is parameter of shape. Parameter ξ indicates tail behavior of GEV. Based on parameter ξ, GEV distribution follows Gumbel distribution when $\xi = 0$, follows Frechet distribution when $\xi > 0$, and follows Weibull distribution when $\xi < 0$.

B. Block Maxima (BM)

BM is extreme value identification method based on the formation of period blocks. The data of observation are devided into certain blocks. Based on the formed blocks, it is choosen the maximum value of observation of each block. The choosen maximum value of each block belongs to extreme sample. Extreme value which is taken using BM method follows GEV distribution [8].

C. Spatial Extreme Value (SEV)

There are many data of observation connected with natural happening, they are the data from a happening in a small area in the larger area. Based on the data, it is possible that there is dependency between one spot to another spot in one area of happening. The nearer the distance (h) between locations, it is possible that there is dependency which is more stronger. The distance between locations (s) to-j and to-k can be counted by using distance measurement with equation of

$$h_{j,k} = \| s_j - s_k \| \quad (3)$$

D. Max-Stable Process (MSP)

MSP is stocastical process, the enlargement of distribution of *multivariate extreme value* to the infinity dimension. $\{Z(s)\}_{s\epsilon R^d}$ is said *max-stable* if a constant$a_n(s) > 0$ and $b_n(s) \in$ R, so

$$Z(s) = \lim_{n\to+\infty}\frac{\max_{i=1}^{n}\{x_i(s)\}-b_n(s)}{a_n(s)},\ n\to\infty, s\in R^d \quad (4)$$

$x_i(s)$ distributes identical independent random [6].

Z(s) is said *max-stable*if and only follows distribution of GEF which constitutes distribution for extreme happening data. Frechet distribution has the fattest shape of tail compared with Gumbel dan Weibull distribution. So, if $a_n(s) = n$, $b_n(s) = 0$, $Z(s) = 0$, $Z(s)$ can be generalized into Frechet unit.

$$F(X) = \exp(-\frac{1}{Z}),\ Z > 0 \quad (5)$$

[9] mentions that Z constitutes the form of transformation of X, with transformation function of

$$Z = \left(1 + \xi \frac{X-\mu}{\sigma}\right)_+^{1/\xi} \tag{6}$$

whereas $a_+ = \max(0; a)$.

E. Model Smith

CDF Model of *Smith* is

$$F(Z_j, Z_k)=exp\left\{-\frac{1}{Z_j}\Phi\left(\frac{a(h)}{2}+\frac{1}{a(h)}log\left[\frac{Z_k}{Z_j}\right]\right)-\frac{1}{z_k}\Phi\left(\frac{a(h)}{2}+\frac{1}{a(h)}log\left[\frac{Z_j}{Z_k}\right]\right)\right\} \tag{9}$$

Z_j is variable Z locationto-j, Z_k is variable Z locationto-k,Φ is CDF bivariat normal standart, $a(\boldsymbol{h_{j,k}})$ is $\sqrt{\boldsymbol{h_{j,k}}^T \boldsymbol{\Sigma_{j,k}}^{-1} \boldsymbol{h_{j,k}}}$, and $\boldsymbol{\Sigma_{j,k}}$ is matrix covarian of location variable to-j and to-k.

F. Koefisien Ekstremal

Extremal coeficient constitutes coeficient used to see dependency level between one variable with another variable. Extremal coeficient of *Smith* Model MSP has the range of value $1 \le \theta(\boldsymbol{h_{j,k}}) \le 2$. The more approaching the value of $\Theta(\boldsymbol{h_{j,k}})$ to 1 indicates the more dependent between the two variables. Extremal coeficient of *Smith* MSP Model is [11]

$$\Theta(\boldsymbol{h_{j,k}}) = 2\Phi\left(\sqrt{\boldsymbol{h_{j,k}}^T \boldsymbol{\Sigma_{j,k}}^{-1} \boldsymbol{h_{j,k}}}/2\right) \tag{10}$$

G. Takeuchi Information Criterion (TIC)

The result of parameter estimation *of Smith* produces the value of $\boldsymbol{\beta}$ which is used to form *trend surface* model. *Trend surface model* is linear model which combines coordinate variable of one spot or location, it constitutes *lon* (*longitude*) variable and *lat* (*latitude*) variable, parameter of $\boldsymbol{\beta}$. Moreover the best *trend surface* model of a number of combination is used for estimating *return level.* Determination of the best *trend surface* model is done by counting the value of TIC. Model with the least TIC value constitutes the best model [12].

$$\text{TIC} = -2\, lp(\boldsymbol{\beta}) + 2\ \text{tr}\ [\ \text{H}(\boldsymbol{\beta})^{-1}\ \text{J}(\boldsymbol{\beta})] \tag{11}$$

With :

$l_p(\boldsymbol{\beta})$ = function *ln pairwise likelihood* $\sum_{j=1}^{m-1}\sum_{k=j+1}^{m} ln\, f(Z_j, Z_k; \boldsymbol{\beta})$

$H(\boldsymbol{\beta})^{-1}$ = $-\ lim_{n\to\infty} n^{-1}\frac{\partial^2 l_p(\boldsymbol{\beta})}{\partial\boldsymbol{\beta}\,\partial\boldsymbol{\beta}^{\mathrm{T}}}$

$J(\boldsymbol{\beta})$ = $cov\left[n^{-1/2}\frac{\partial l_p(\boldsymbol{\beta})}{\partial\boldsymbol{\beta}}\right]$

H. Return Level

Return level is maximum value which can be achieved in certain period. *Return level* value constitutes the extreme value of prediction. *Return level* for a location (s) is [8]

$$z_p(s) = \hat{\mu}(s) - \frac{\hat{\sigma}(s)}{\hat{\xi}(s)}\left(1 - \left[-\ln\left(1-\frac{1}{\mathrm{T}}\right)\right]^{-\hat{\xi}(s)}\right) \tag{12}$$

T is the number of blocks in one interval of the predicted period. The achieved probability of $z_p(s)$ is $p = \mathrm{P}(\mathrm{X} > z_p) = \frac{1}{T}$.

I. Maximum Likelihood Estimation (MLE)

The function of *likelihood* $L(\boldsymbol{\Theta})$ for independent random sample *X* having measurement of *n* from PDF $f(X;\boldsymbol{\Theta})$ is

$$L(\boldsymbol{\Theta}) = \prod_{i=1}^{n} f(X;\boldsymbol{\Theta}) = f(x_1;\boldsymbol{\Theta})\ f(x_2;\boldsymbol{\Theta}) \ldots\ f(x_n;\boldsymbol{\Theta}) \tag{13}$$

Estimator of parameter of $\boldsymbol{\Theta}$ ($\boldsymbol{\Theta}$ in this research is parameter of $\boldsymbol{\mu}$, $\boldsymbol{\sigma}$, and $\boldsymbol{\xi}$) is acquired from counting the first deferential of the function and equalizes it with zero.

$$\frac{\partial\, ln\, L(\boldsymbol{\Theta})}{\partial \boldsymbol{\Theta}} = 0 \tag{14}$$

if and only if

$$\frac{\partial L(\boldsymbol{\Theta})}{\partial \boldsymbol{\Theta}} = 0 \tag{15}$$

So, it can be acquired the maximum estimator of $\boldsymbol{\Theta}$ more easily by the counting in $ln\ L(\boldsymbol{\Theta})$ [13].

J. Maximum Composite Likelihood Estimation (MCLE)

MCLE method can siplify the counting substantially and produce the expected estimators, they have the characters unbias, consintent, and normal [14]. The same as *Maximum Pairwise Likelihood Estimation* (MPLE), this method basically changes the use of higher dimension PDF into lower dimension PDF. MPLE involves 2 dimensions (2 variables), mean while MCLE involves PDF of variables which are considered independent. This *likelihood* methodis also called the independent *likelihood* method. The function of *compositelikelihood* with *m* location variables and parameter$\boldsymbol{\beta}$ ($\boldsymbol{\beta}$ in this research is parameters $\boldsymbol{\beta}_{\mu}, \boldsymbol{\beta}_{\sigma}, \boldsymbol{\beta}_{\xi}$) can be written as [15] :

$$Lc(\boldsymbol{\beta}) = \prod_{i=1}^{n} L_i(\boldsymbol{\beta})^{w_n} \tag{16}$$

with w_m is nonnegatif optional weighting, so if w_m= 1, the function of *composite likelihood* will be

$$Lc(\boldsymbol{\beta}) = \prod_{i=1}^{n} L_i(\boldsymbol{\beta}) \tag{17}$$

with

$$L(\boldsymbol{\beta}) = \prod_{j=1}^{m} f(\boldsymbol{\beta}) \tag{18}$$

K. Maximum Pairwise Likelihood Estimation (MPLE)

MPLE is parameter estimation method using the function of density *pairwise* or in pair of two variables. MPLE method replaces the function ($L(\boldsymbol{\beta})$) in MLE with the function of *pairwise likelihood* $L_p(\boldsymbol{\beta})$.

$$L_p(\boldsymbol{\beta}) = \prod_{i=1}^{n} \prod_{j=1}^{m-1} \prod_{k=j+1}^{m} f\left(x_{ji}, x_{ki}; \boldsymbol{\beta}\right) \tag{19}$$

$f\left(x_{ji}, x_{ki}; \boldsymbol{\beta}\right)$ constitutes PDF bivariat with parameter $\boldsymbol{\beta}$ and i = 1, 2, … n is observation on each variable [9].

L. Broyden-Fletcher Goldfarb-Shanno (BFGS) Quasi Newton

Numerical iterasion method BFGS *Quasi Newton* constitutes the improvement of *Newton Iteration Method*. This Method is introduced by [16], [17], [18], and [19]. The equation of iteration method BFGS*Quasi Newton*is :

$$\underset{\sim}{\boldsymbol{\theta}}^{(k+1)} = \underset{\sim}{\boldsymbol{\theta}}^{(k)} + \alpha^{(k)} S^{(k)} \tag{20}$$

$\underset{\sim}{\boldsymbol{\theta}}^{(k)}$ = initial value
$H\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)^{-1}$ = invers of Hessian matrix
$g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)$ = matrix which elements contain the first deferential of $\underset{\sim}{\boldsymbol{\theta}}^{(k)}$.

whereas $\alpha^{(k)}$ constitutes the function for minimizing *error.*

$$\alpha^{(k)} = \arg\min\left[f\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)} + \alpha^{(k)} S^{(k)}\right)\right] \tag{21}$$

$$S^{(k)} = -(H^{(k)}) g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) \tag{22}$$

Then counting the change $\Delta\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) = \alpha^{(k)} S^{(k)}$ and

$$\Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) = g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k+1)}\right) - g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) \tag{23}$$

so will be acquired the equation of

$$H^{(k+1)} = H^{(k)} + \left(1 + \frac{\Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)^T H^{(k)} \Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)}{\Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)^T \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)}}\right) \frac{\Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)} \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)T}}{\Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)T} \Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)} - \frac{H^{(k)} \Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)T} + \left(H^{(k)} \Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)T}\right)^T}{\Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)^T \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)}} \tag{24}$$

$H^{(k)}$ is simetricaland nonsingular matrix. $H^{(0)}$ is choosen by identical matrix which renewed by (24) in the next iteration [20]. Iteration is done until $|\underset{\sim}{\boldsymbol{\theta}}^{(k+1)} - \underset{\sim}{\boldsymbol{\theta}}^{(k)}| \le e$ with *e* is the very small figure [21].

M. Anderson DarlingTest

Anderson Darling Test is a test used to find out whether a date follows certain distribution. GEV distribution testing toward two extremes can be done by using Anderson Darling test with the following procedure [22] :

1. Hypothesis formulation :
   H_0 : $F(x) = F^*(x)$ (Data followstheoritical distribution $F^*(x)$)
   H_1 : $F(x) \neq F^*(x)$ (Data doesn't followtheoritical distribution $F^*(x)$)

   In the case of rainfall, theoritical distribution used is GEV distribution
2. Statistics test

$$AD = -n - \frac{1}{n}\sum_{i=1}^{n}(2i-1)\left(ln(x_i) + ln(1-(x_{n+1-i}))\right) \tag{25}$$

   $F(X)$ is CDF of sample data
   $F^*(X)$ is theoritica CDF
3. Criterion of tes
   Ignore H_0 if AD>critical value of AD tabel, or *p-value* < *α*.

N. Rainfal

Rainfall isthe altitude of rainwater compiledin a rainmeteron theflat place, not to absorb, not to permiate, and not toflow. Extreme raifall is rainfall which has intensity of >100 milimeter per day. Rainfall with intensity of > 50 milimeter per day constitutes heavy rainfall. Based on the classification of monthly average rainfall distribution pattern inall Indonesia areaconsists of 342 Zone of Season patterns,

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and 65 Non Zone of Season. Zone of Season is an area which average rain pattern has clear limit climatologically between dry season period and rainy season period. Oneregency or city may consist of some Zone of Season. Non Zone of Season is areas which doesn't have the clear limit climatologically between rainy season periodand dry season [23].

III. DISCUSSION

Calculation of *retun level* needs a number of estimator namely $\hat{\mu}(s)$, $\hat{\sigma}(s)$, and $\hat{\xi}(s)$ which values have been counted first through a Trend Surface Model. Trend Surface Model

$$\mu(x) = \beta 0,\ +\beta 1,\mu lon(s) + \beta 2,\mu lat(s)$$
$$\sigma(x) = \beta 0,\sigma + \beta 1,\sigma lon(s) + \beta 2,\sigma lat(s)$$
$$\xi(x) = \beta 0,\xi$$

in its calculation needs the values of parameter β (β_0, β_1, β_2) which must be estimated first from Smith Model. Estimation process of Smith Model's parameter it self needs the values of estimator $\mu(x)$, $\sigma(x)$, and $\xi(x)$ which is acquired by doingestimation to GEV distribution parameter.

A. GEV Distribution Parameter Estimation

1. Arranging the function of likelihood of PDF GEV

$$L(\mu,\sigma,\xi) = \prod_{i=1}^{n} f(x_i)$$
$$= \left(\frac{1}{\sigma}\right)^n \prod_{i=1}^{n} \left\{ \left[1+\xi \frac{x_i-\mu}{\sigma}\right]^{-\frac{1}{\xi}-1} \right\} \exp\left(-\sum_{i=1}^{n}\left[1+\xi\frac{x_i-\mu}{\sigma}\right]^{-\frac{1}{\xi}}\right).$$

2. Function of *likelihood* is carried out in the form of ln

$$\ell(\mu,\sigma,\xi) = -n\ln\sigma - \left(1+\frac{1}{\xi}\right)\sum_{i=1}^{n}\ln\left[1+\xi\frac{x_i-\mu}{\sigma}\right] - \sum_{i=1}^{n}\left[1+\xi\frac{x_i-\mu}{\sigma}\right]^{-\frac{1}{\xi}}$$

3. Derivation of function of *likelihood* toward parameter needs to be estimated
   a. *Derivation toward parameterμ*

$$\frac{\partial\ell(\mu,\sigma,\xi)}{\partial\mu} = \left(\frac{1+\xi}{\sigma}\right)\sum_{i=1}^{n}\left[1+\xi\left(\frac{x_i-\mu}{\sigma}\right)\right]^{-1} - \frac{1}{\sigma}\sum_{i=1}^{n}\left[1+\xi\left(\frac{x_i-\mu}{\sigma}\right)\right]^{-\frac{1}{\xi}-1} = 0$$

   b. Derivation toward parameter σ

$$\frac{\partial\ell(\mu,\sigma,\xi)}{\partial\sigma} = -\frac{n}{\sigma} + (1+\xi)\sum_{i=1}^{n}\left(\frac{x_i-\mu}{\sigma^2}\right)\left(1+\xi\left(\frac{x_i-\mu}{\sigma}\right)\right)^{-1}$$
$$-\sum_{i=1}^{n}\left(\frac{x_i-\mu}{\sigma^2}\right)\left[1+\xi\left(\frac{x_i-\mu}{\sigma}\right)\right]^{-\frac{1}{\xi}-1} = 0$$

   c. Derivation toward parameter ξ

$$\frac{\partial \ell(\mu,\sigma,\xi)}{\partial \xi}=\frac{1}{\xi^2}\sum_{i=1}^{n}\ln\left[1+\xi\left(\frac{x_i-\mu}{\sigma}\right)\right]-\left(\frac{1}{\xi}+1\right)\sum_{i=1}^{n}\left[1+\xi\left(\frac{x_i-\mu}{\sigma}\right)\right]^{-1}\left(\frac{x_i-\mu}{\sigma}\right)$$

$$-\sum_{i=1}^{n}\left[1+\xi\left(\frac{x_i-\mu}{\sigma}\right)\right]^{-\frac{1}{\xi}}\left[\frac{1}{\xi^2}\sum_{i=1}^{n}\ln\left[1+\xi\left(\frac{x_i-\mu}{\sigma}\right)\right]-\frac{1}{\xi}\sum_{i=1}^{n}\frac{\left(\frac{x_i-\mu}{\sigma}\right)}{1+\xi\left(\frac{x_i-\mu}{\sigma}\right)}\right]=0$$

Estimation using MLE gives a result in the form of equation which is not *closed form.* This equation can not be used to arrange function which can estimate parameter. Based on this reason, the estimation of parameter must be continued by using numerical iteration. Numerical iteration used in this research is BFGS Quasi Newton.

B. Smith Model Parameter Estimation using MCLE

Function of *composite like lihood* with *m* variables

$$Lc(\boldsymbol{\beta}) = \prod_{i=1}^{n} L_i(\boldsymbol{\beta})$$

with $L(\boldsymbol{\beta}) = \prod_{j=1}^{m} f(\boldsymbol{\beta})$, indicatesthat as many as *m* variables MCLE involvolves PDF of variables which is considered as independent, never theless, this *likelihood* method is also called independent *likelihood* method.

In the case of spatial, variable of rainfallas many as *m* locationis considered as mutual dependent, related to appropriate with how far is it the distance between locations. Variable of rainfall on as many as *m* locations considered as variable *m* variable rain fall which is dependent. It is not appropriate with MCLE method which involves *m* involved variables which is independent. Never theless, Smith Model parameter estimation is not appropriate to use MCLE method.

C. Smith Model Parameter Estimation Using MPLE

1. Arranging PDF Smith Model based on CDF Smith Model

$$F(Z_j,Z_k) = exp\left\{-\frac{1}{Z_j}\Phi\left(\frac{a(h)}{2}+\frac{1}{a(h)}log\left[\frac{Z_k}{Z_j}\right]\right)-\frac{1}{z_k}\Phi\left(\frac{a(h)}{2}+\frac{1}{a(h)}log\left[\frac{Z_j}{Z_k}\right]\right)\right\}$$

If

$$w=\frac{a}{2}+\frac{1}{a}\log\left(\frac{z_k}{z_j}\right)$$

$$v=\frac{a}{2}+\frac{1}{a}\log\left(\frac{z_j}{z_k}\right)$$

$j = 1, 2, \ldots, m-1$ end $k = 2, 3, \ldots, m$

CDF Smith Model can be written as

$$F(\mathrm{Z}_j,\mathrm{Z}_k)=\exp\left(-\frac{\Phi w}{Z_j}-\frac{\Phi)}{Z_k}\right)$$

$$f(z_j, z_k) = \frac{\partial^2}{\partial z_j \partial z_k} F(z_j, z_k)$$

$$= \exp\left(-\frac{\Phi w}{z_j} - \frac{\Phi v}{z_k}\right) \times \left\{\left(\frac{\Phi w}{z_j^2} + \frac{\varphi w}{a z_j^2} - \frac{\varphi v}{a z_j z_k}\right)\right.$$

$$\left. \times \left(\frac{\Phi v}{z_k^2} + \frac{\varphi v}{a z_k^2} - \frac{\varphi w}{a z_j z_k}\right) + \left(\frac{v \varphi w}{a^2 z_j^2 z_k} + \frac{w \varphi v}{a^2 z_j z_k^2}\right)\right\}$$

2. Arranging the function of *pairwise likelihood* of PDFSmith Model

$$L_p(\boldsymbol{\beta}) = \sum_{j=1}^{M-1} \sum_{k=j+1}^{M} f(z_j, z_k)$$

$$= \sum_{j=1}^{M-1} \sum_{k=j+1}^{M} \left(\exp\left(-\frac{\Phi w}{z_j} - \frac{\Phi v}{z_k}\right) \times \left\{\left(\frac{\Phi w}{z_j^2} + \frac{\varphi w}{a z_j^2} - \frac{\varphi v}{a z_j z_k}\right)\right.\right.$$

$$\left.\left. \times \left(\frac{\Phi v}{z_k^2} + \frac{\varphi \mathrm{v}}{a z_k^2} - \frac{\varphi \mathrm{w}}{a z_j z_k}\right) + \left(\frac{v \varphi w}{a^2 z_j^2 z_k} + \frac{w \varphi v}{a^2 z_j z_k^2}\right)\right\}\right)$$

Based on this function, there haven't been parameter $\boldsymbol{\beta}$ which will be estimated. Nevertheless, parameter $\boldsymbol{\beta}$ is appeared by elaborating upon variable Z with its function of transformation.

$$Z = \left(1 + \xi \frac{X - \mu}{\sigma}\right)^{1/\xi}$$

In this stage estimation involves variabel X, so it must be formed a function of pairwise using fungction of this variables by using equation of

$$f(X_j, X_k) = f_{Z_j, Z_k}\left[g^{-1}(X_j, X_k)\right] \left|J(X_j, X_k)\right|$$

$$\left|J(X_j, X_k)\right| = \frac{1}{\sigma_j \sigma_k} \left(1 + \frac{\xi_j (X_j - \mu_j)}{\sigma_j}\right)_+^{1/\xi_j - 1} \times \left(1 + \frac{\xi_k (X_k - \mu_k)}{\sigma_k}\right)_+^{1/\xi_k - 1}$$

Resulting

$$
\begin{aligned}
f(X_j, X_k) = & \left(\exp\left(-\frac{\Phi w}{\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}} - \frac{\Phi v}{\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}} \right) \right. \\
& \times \left(\frac{\Phi w}{\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}} + \frac{\varphi w}{a\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}} - \frac{\varphi v}{a\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}} \right) \\
& \times \left(\frac{\Phi v}{\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}} + \frac{\varphi \mathrm{v}}{a\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}} - \frac{\varphi \mathrm{w}}{a\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}} \right) \\
& \left. + \left(\frac{v\varphi w}{a^2\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}} + \frac{w\varphi v}{a^2\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}} \right) \right) \\
& \times \left(\frac{1}{\sigma_j \sigma_k} \left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j - 1} \times \left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k - 1} \right)
\end{aligned}
$$

$$
\begin{aligned}
L_p(\boldsymbol{\beta}) = & \sum_{j=1}^{M-1} \sum_{k=j+1}^{M} \left(\exp\left(-\frac{\Phi w}{\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}} - \frac{\Phi v}{\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}} \right) \right. \\
& \times \left\{ \left(\left(\frac{\Phi w}{\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}} + \frac{\varphi w}{a\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}} - \frac{\varphi v}{a\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}} \right) \right) \right\} \\
& \times \left(\frac{\Phi v}{\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}} + \frac{\varphi \mathrm{v}}{a\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}} - \frac{\varphi \mathrm{w}}{a\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}} \right) \\
& \left. + \left(\frac{v\varphi w}{a^2\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}} + \frac{w\varphi v}{a^2\left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}} \right) \right) \\
& \times \left(\frac{1}{\sigma_j \sigma_k} \left(1+\frac{\xi_j (X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j - 1} \times \left(1+\frac{\xi_k (X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k - 1} \right)
\end{aligned}
$$

3. Function of *pairwise likelihood* is carried out into the form of ln

$$\ln\left[L_p(\boldsymbol{\beta})\right]=\ln\left[\begin{array}{l}\sum_{j=1}^{M-1}\sum_{k=j+1}^{M}\left(\exp\left(-\frac{\Phi w}{\left(1+\frac{\xi_j(X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}}-\frac{\Phi v}{\left(1+\frac{\xi_k(X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}}\right)\right.\\ \times\left\{\left(\left(\frac{\Phi w}{\left(1+\frac{\xi_j(X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}}+\frac{\varphi w}{a\left(1+\frac{\xi_j(X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}}-\frac{\varphi v}{a\left(1+\frac{\xi_j(X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k(X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}}\right)\right\}\right)\\ \times\left(\frac{\Phi v}{\left(1+\frac{\xi_k(X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}}+\frac{\varphi \mathrm{v}}{a\left(1+\frac{\xi_k(X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}}-\frac{\varphi \mathrm{w}}{a\left(1+\frac{\xi_j(X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k(X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}}\right)\\ +\left(\frac{v\varphi w}{a^2\left(1+\frac{\xi_j(X_j-\mu_j)}{\sigma_j}\right)_+^{2/\xi_j}\left(1+\frac{\xi_k(X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k}}+\frac{w\varphi v}{a^2\left(1+\frac{\xi_j(X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j}\left(1+\frac{\xi_k(X_k-\mu_k)}{\sigma_k}\right)_+^{2/\xi_k}}\right)\Bigg)\Bigg)\\ \times\left(\frac{1}{\sigma_j\sigma_k}\left(1+\frac{\xi_j(X_j-\mu_j)}{\sigma_j}\right)_+^{1/\xi_j-1}\times\left(1+\frac{\xi_k(X_k-\mu_k)}{\sigma_k}\right)_+^{1/\xi_k-1}\right)\end{array}\right]$$

$$\mu = d^T\beta_\mu = [1 \quad d1 \quad d2]\begin{bmatrix}\beta_{0,\mu}\\ \beta_{1,\mu}\\ \beta_{2,\mu}\end{bmatrix}$$

$$\sigma = d^T\beta_\sigma = [1 \quad d1 \quad d2]\begin{bmatrix}\beta_{0,\sigma}\\ \beta_{1,\sigma}\\ \beta_{2,\sigma}\end{bmatrix}$$

$$\xi = \beta_{0,\sigma}$$

The last MPLE estimation process is derivation of function ln *pairwise likelihood* toward $\beta_\mu, \beta_\sigma, \beta_\xi$..

D. Quasi Newton BFGS Iteration Algorithm

1. Determininginitial value $\underset{\sim}{\boldsymbol{\theta}}^{(0)}$ which can be filled with matrix in size of *m with* all its member is zero
2. Determining $\alpha^{(k)} = \arg\min\left[f\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)} + \alpha^{(k)} S^{(k)}\right)\right]$
3. Determining matrix $\boldsymbol{H}^{(k+1)}$

$$H^{(k+1)} = H^{(k)} + \left(1 + \frac{\Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)^{T} H^{(k)} \Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)}{\Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)^{T} \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)}}\right) \frac{\Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)} \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)T}}{\Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)T} \Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)}$$
$$- \frac{H^{(k)} \Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)T} + \left(H^{(k)} \Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)T}\right)^{T}}{\Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)^{T} \Delta \underset{\sim}{\boldsymbol{\theta}}^{(k)}}$$

with

$H^{(0)} = I$ (matrix identity in size of m)

$\Delta g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) = g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k+1)}\right) - g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)$

4. Determining $g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)$namelymatrixwhich elementscontainingthe first derivation of $\underset{\sim}{\boldsymbol{\theta}}^{(k)}$
5. Determining $S^{(k)} = -(H^{(k)}) g\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right)$
6. Doing numerical iteration by using equation
$$\underset{\sim}{\boldsymbol{\theta}}^{(k+1)} = \underset{\sim}{\boldsymbol{\theta}}^{(k)} + \alpha^{(k)} S^{(k)}$$
7. Calculating $\Delta\left(\underset{\sim}{\boldsymbol{\theta}}^{(k)}\right) = \underset{\sim}{\boldsymbol{\theta}}^{(k+1)} - \underset{\sim}{\boldsymbol{\theta}}^{(k)}$
8. Back to the process number 2 up to the process number 7

Iteration is started from k = 1 and finished if $|\underset{\sim}{\boldsymbol{\theta}}^{(k+1)} - \underset{\sim}{\boldsymbol{\theta}}^{(k)}| \le e$ with e is very small value.

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M – 27

Rainfall Forecasting Using Bayesian Nonparametric Regression

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***Abstract*—** In the present years, climate change due to global warming, resulting in the change of seasons in Indonesia is high variability and unpredictable. Many methods that can be used to predict rainfall pattern, such as parametric regression and ARIMA. However, the model obtained through parametrics statistical approach only concerned to information of samples, therefore, it is poor to interpret the parameters of the rainfall pattern. This study proposes a bayesian nonparametric regression with Gaussian Regression Process approach for rainfall forecasting in the City of Makassar, Indonesia. Based on the value of Root Mean Square Error Prediction (RMSEP), the best covariance function that can be used to forecast is quadratic exponential.

Keywords: *quadratic exponential, rainfall forecasting, regression gaussian process, RMSEP*

I. INTRODUCTION

In the latitude and longitude, the characteristics of equatorial and monsoonal circulations in Indonesia are very different. These natural conditions resulting the rainfall in Indonesia are very unstable, complex, and have high variability. This climate change, due to global warming, also have resulted irregular change of seasons in various regions in Indonesia including the city of Makassar. This natural phenomenon causes that the currently rainfall is very difficult to predict accurately with traditional forecasting methods. Even in climatology, rainfall in Indonesia has become one of the most difficult factor to be predicted accurately.

Along with the development of modern technology, technology of rainfall forecasting has also developed rapidly, ranging from deterministic approach to the stochastic approach (Sutikno et al, 2010). The deterministic approach conducts through an analysis based on physical laws expressed in mathematical forms by using the classical statistics approaches such as (ARIMA), Fourier analysis, analysis of Kalman Filter and other methods. These forecasting methods are widely used to identify the relationship between rainfall and temperature, air pressure, wind velocity, air humidity, and solar radiation intensity (Pramudia *et al*, 2008).

Besides those approaches, some researchers concerning to climate and weather have also developed a model of rainfall prediction based on nonparametric models and based on neural networks (Estiningtyas and Kharmila 2008, Subarna 2009, Warsito and Sri, 2007). Nevertheless, the parameter estimations of model and their inferences only concern to the information from the samples obtained and ignore the prior information from researchers or field workers. According to Casella and Berger (2002), this classical approach has drawbacks in term of interpretation of the confidence interval of a parameter model. The significance of the confidence interval of a model parameter can not be based on the real level setting up before building the model.

To overcome the problem, a predictive model that can be used is Nonparametric Bayesian approach i.e. Gaussian Process Regression (GPR). The advantage of nonparametric models lies in the flexibility form of the model, in particular there are no assumptions on the parametric form (Eubank, 1999; Takezawa, 2006). Bayesian models can accommodate the researchers' prior information. Prior information is usually quantified into distribution form the parameters or the functions (Box and George, 1973).

Some researchers had used the Gaussian process regression approach to develop a model from the cases faced. Williams and Rassmusen, *et al* (2006) used the Gaussian process regression to obtain a model on the robot arm motions. In addition, Chen, *et al* (2007) used the Gaussian process regression to develop a calibration model on the spectroscopic data. Therefore, this study proposes the use of Gaussian processes regression to forecast the rainfall in the city of Makassar, Indonesia. The results of this study are expected to be able to generate a good estimation value of Gaussian Process Regression model parameter so that it produces an accurate rainfall forecasting.

II. MATERIAL AND METHOD

This study uses data of 120 observations obtained each month for last 10 years, from January 2006 to December 2015. The data are obtained from Indonesian Agency for Meteorology, Climatology, and Geophysics of province of South Sulawesi. The data used consist of one dependent variable that is the amount of rainfall (Y), and four independent variables namely; air humidity (X1), air temperature (X2), air pressure (X3), and wind velocity (X4).

The definitions of each variable used in this forecasting include; (1) rainfall is defined as the amount of water that falls on the flat land surface on certain period measured in height unit (mm) none of evaporation over horizontal surface, runoff and infiltration, (2) air humidity is the amount of water vapor content or water vapor concentration in the air measured in percentage (%), (3) air temperature is the level or degree of heat from the activity of molecules in the atmosphere or the size of kinetic energy average from the movement of molecules in the atmosphere measured in Celsius unit (^{0}C), (4) the air pressure is the pressure appeared by weight of air layer or pressure working to move air mass in each certain area unit measured in millibar (mb), and (5) wind velocity is the speed of air moving horizontally at a height of two meters above the ground measured in knot.

In analyzing the data, researcher conducts several procedure stages: the first, identify distribution patterns of Gaussian of variables used in the study, the second, make Gaussian process regression model with a review and an assignment of covariance function that will be used, the third, validate the result model of stage 2 with the criteria of Root Mean Square Error Prediction (RMSEP), and the fourth, make a prediction of the amount of monthly rainfall in 2016.

III. RESEARCH RESULTS

A. Graphic Desciption of Each Variable

Figure 1 is a graph of the dynamics of monthly rainfall from 2006 to 2015. One millimeter of rainfall means that one square meter area on the flat land accommodates as high as one millimeter of water or as much as one liter of water. Rainfall intensities are the amount of rainfall in certain time period.

Big intensity means heavy rain and this condition is very dangerous because the impact can cause flood, landslide, and drawback effect to the plants. Short-term rainfall is stated in per hour intensity called as rainfall intensity (mm/hr). The rainfall intensity average is in ½ hour. The amount of rainfall intensities are different due to rainfall durations or occurrence frequencies. Varieties of time distribution of a rainfall records can give signs of the increasing or decreasing of tendency. For the monthly rainfall occurring based on the graph, there is no repeated frequency in a year, so that it does not make a seasonal distribution. It shows that the diversity of the amount of annual rainfall is quite high. In addition, standard deviation reaches 273.1243 mm. The highest monthly amount of rainfall occurs in January of 2013 reaching 982 mm.

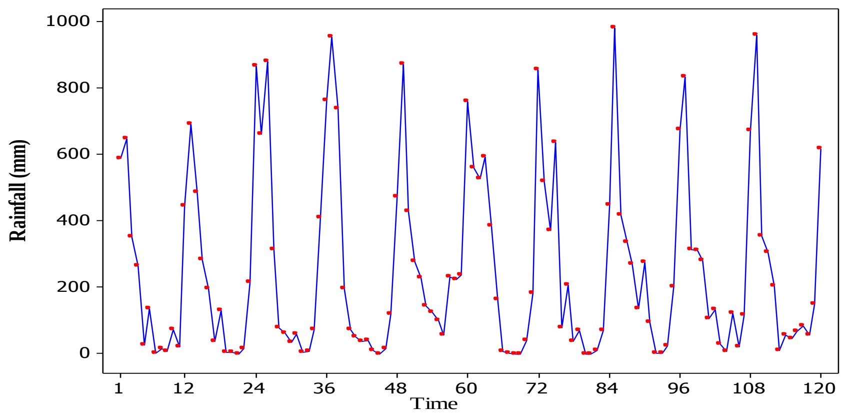

FIGURE 1. GRAPH OF THE MONTHLY RAINFALL IN THE CITY OF MAKASSAR IN 2006-2015

Furthermore, the dynamics of air humidity are presented in Fig. 2., which is the graph of the dynamics of air humidity are from 2006 to 2015. It can be seen that the air humidity each month at the early year tends to be high, while on August and September tend to decrease. The increasing and decreasing of air humidity is relatively low because the city of Makassar is in the equatorial area having tropics climate. Generally, the annual air humidity is in the range 67% to 97%. It states that the tendency of the temperature is above of the temperature average i.e. 79%.

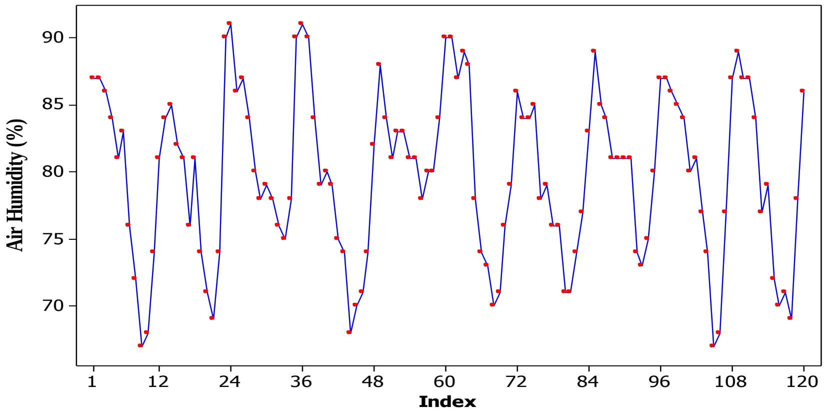

FIGURE 2. GRAPH OF THE AIR HUMIDITY IN THE CITY OF MAKASSAR IN 2006-2015

The dynamics of the air temperature average from 2006 to 2015 is revealed in Fig. 3. It shows that the annual air temperature average is erratic each month, but the annual air temperature average is generally in the range of 26.3 ^{0}C to 29 .4 ^{0}C. It states that the tendency of the temperature is above the average i.e. 27.78 ^{0}C.

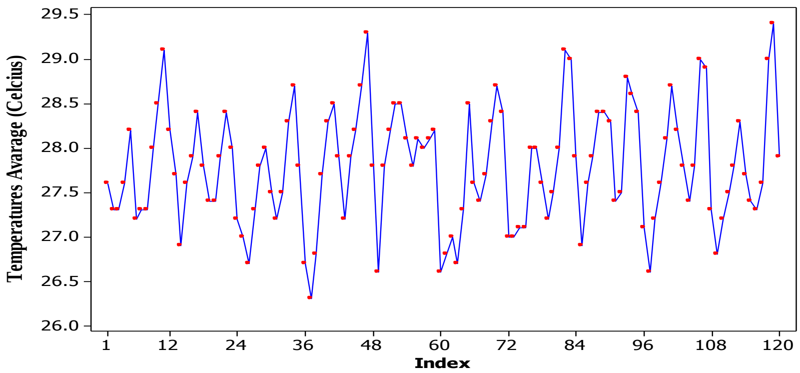

FIGURE 3. GRAPH OF THE AIR TEMPERATURE AVERAGE IN THE CITY OF MAKASSAR IN 2006-2015

The dynamic of air pressure from 2006 to 2015 is shown in Fig. 4. It shows that the dynamics of air pressure is in addictive pattern. The kinds of data has increased every year from the early 2012, but the annual air pressures are generally in the range of 1008 mb to 1013 mb. It reveals that the tendency of air pressure is above the air pressure average reaching 1010.72 mb.

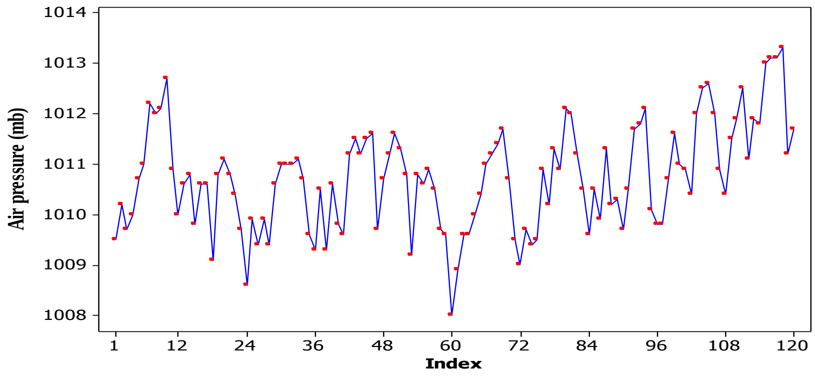

FIGURE 4. GRAPH OF THE AIR PRESSURE IN THE CITY OF MAKASSAR IN 2006-2015

Figure 6 is a graph of the dynamics of the wind velocity from 2006 to 2015. The dynamics of wind velocity tends to be almost the same from 2011 to 2015, unless the early 2014 the wind velocity is increasing. But the annual wind velocity are generally in the range from 2 knots to 7 knots. It shows that the tendency of the wind velocity is above the average air pressure i.e. 4.5 knots.

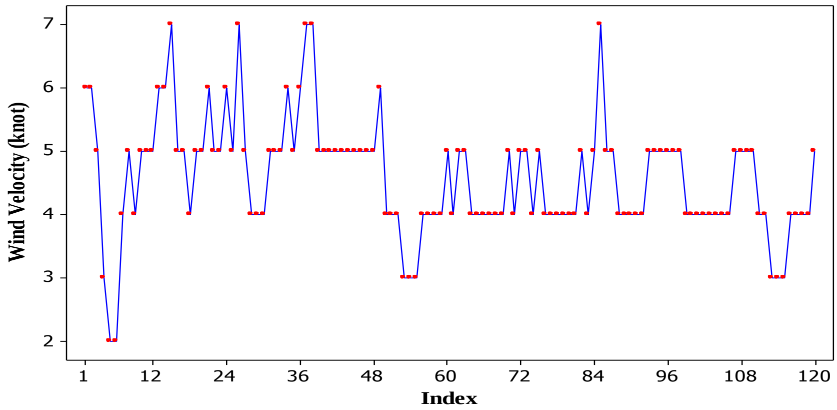

FIGURE 5. GRAPH OF THE WIND VELOCITY IN THE CITY OF MAKASSAR IN 2006-2015

B. Selection of Covariance Function

A crucial aspect of modeling Gaussian process regression is selection of covariance function. This study uses a Quadratic Exponential covariance function. Hyper-parameter values are estimated by using marginal maximum likelihood method. Table 1 shows the estimated value of the hyper-parameters of covariance function.

The covariance functions examined in this study are: (1) the function of Quadratic Exponential Covariance with distance measurements of Automatic Relevance Determination (QE-ARD), (2) the Linear covariance function with the Automatic Relevance Determination parameters (Linear-ARD), (3) the Linear covariance function with single hyper-parameter (Linear-1), and (4) Quadratic Exponential covariance function with the Isotropic distance measurement (QE-Iso).

The covariance function is conducted with concerning to the value resulted on RMSEP. After the covariance functions above are attempted to be used in the Gaussian process regression modeling, the results are shown at Table 1. It can be concluded that the covariance function, which is relevant to smallest value RMSEP, is obtained when the Gaussian process regression model uses quadratic exponential covariance function (QE-ARD), which is 137.0867. Furthermore, the covariance function will be used to predict the amount of rainfall in 2016.

TABEL 1. ESTIMATION VALUE OF HYPER-PARAMETER OF COVARIANCE FUNCTION AND RMSEP

Covariance Function	Hyper-parameter	Parameter Estimation	RMSEP
Quadratic exponential (QE- ARD)	Length scale 1 Length variance 2 Signal variance Error variance	11.285 10.185 8074.285 16034.730	137.087
Linear ARD	Bias parameter Controller 1 Bias parameter Controller 2 Error variance	10.215 10.305 20798.480	142.357
Linear-1	Bias parameter Controller Error variance	10.225 20798.48	142.327
quadratic exponential-Iso	Length scale Signal variance Error variance	8981.035 11.445 16227.670	139.857

C. Rainfall Forecasting in 2016

Before performing a prediction of the amount of monthly rainfall during 2016, the first stage is making predictions of the air humidity, the air temperature average, the air pressure, and the wind velocity during 12 months in 2016. In this case, the method used is the moving average with the period 3. The result of the prediction is shown at Table 2.

The prediction about air pressure is revealed at Table 2, the highest values is on September and October in 2016 with 1011.6 mb and the lowest value is in February 2016 reaching 1009.1 mb, the highest monthly temperature average is 28.7 ^{0}C falling in September 2016 and the lowest temperature average is in October 2016 with 26.6 ^{0}C. Based on the prediction, the highest value of air humidity is in August 2016 with 91% and the lowest value -which reached 71%- is in October 2016, while the highest value of the wind velocity based on the prediction is in May 2016 reaching 7 knots and the lowest value is in January 2016 reaching 2 knots.

TABEL 2. ESTIMATION VALUE OF HYPER-PARAMETER OF COVARIANCE FUNCTION AND RMSEP

Month	Air humidity (%)	Temperature average (^{0}C)	Air pressure (mb)	Wind velocity (knot)
January	83	27.2	1011.0	2
February	81	27.8	1009.1	4
March	90	28.0	1009.7	5
April	86	27.0	1009.9	5
May	87	26.7	1009.4	7
June	78	27.2	1011.0	5
July	75	28.3	1011.1	5
August	91	26.7	1009.3	6
September	79	27.7	1010.6	5
October	71	28.7	1011.6	5
November	88	26.6	1011.2	6
December	83	28.5	1009.2	3

The prediction results of air pressure, temperature average, humidity and wind velocity in 2016 will be the input for the interest amount of rainfall prediction in 2016 by using a Gaussian process regression model. Prediction of rainfall for 12 months using Gaussian process regression model shows at Table 3. Table 3 shows that the highest amount of rainfall prediction on the February reaching 787.2 mm with diversity 881 mm and the lowest in July 2016 reaching 38.3 mm with diversity 6 mm.

TABEL 3. ESTIMATION VALUE OF HYPER-PARAMETER OF COVARIANCE FUNCTION AND RMSEP

Month	Rainfall	Standard deviation
January	626.2	137
February	787.2	881
March	110.4	251
April	455.9	662
May	287.2	130
June	62.0	35
July	38.3	6

August	747.7	764
September	151.8	197
October	39.6	16
November	700.6	873
December	544.5	114

IV. DECISSION

Nowadays, the rainfall forecasting has also developed rapidly beginning from the deterministic approach to the stochastic approach. Gaussian process regression is one of methods that can be used to do that. This method is classified in category of non-parametric Bayesian regression model where the model specification connecting between dependent variable and independent variables is not needed to be set in advance. The data are allowed to "speak to themselves" to form the relevant structure models. Gaussian process regression using stochastic approach assumes that the amount of rainfall is random. Based on the value of Root Mean Square Error Prediction (RMSEP), the best covariance function which can be used to predict is Quadratic Exponential Automatic Relevance Determination parameters (QE-ARD) with RMSEP i.e. 137.0867. The prediction of the highest amount of rainfall is on February reaching 787.2 mm with 881 mm and the lowest amount of rainfall is in July 2016 i.e. 38.3 mm with 6 mm. Compared to other classical methods that are not able to accommodate the initial information and not to impose the modeling, Gaussian process regression approach is relatively good to be used.

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M – 28

Least Squares Estimator for β in Multiple Regression Estimation

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***Abstract*—**Regression analysis has been developed to study the pattern and measure the statistical relationship between two or more variables . Mechanical analysis that attempts to explain the relations between two or more variables or more specifically the relationship between variables containing causation is called regression analysis . The procedure is based on the analysis of joint probability distribution variables. If this relationship can be expressed in a mathematical equation , it can be used in everyday purposes , for example to make predictions , fortune telling , and so on

Overall regression test with paramater (parametric regression) and regression without parameter (semiparametric regression) in advance will be discussed for parametric regression parameters $\boldsymbol{\beta_1}$, $\boldsymbol{\beta_2}$, …, $\boldsymbol{\beta_{m-1}}$, $\boldsymbol{\beta_m}$ which is an element β in a model y = Xβ + ε. in this case will assume that y distribution Nn (Xβ, σ2I), where X notated n x (m+1) from rank m+1 < n.

Least Square approach to estimation of the β in the fixed model, for the parameter $\beta_0, \beta_1, \beta_2, \ldots \ldots \beta_m$, estimators that minimize the sum of squares of deviations of the n observed y from their predicted values $\hat{y}$.

Keywords: *regression, estimator, least square.*

I. INTRODUCTION

In everyday life there are things that can be solved using mathematics, statistics is one way to collect data, process, analyze and conclude. Regression analysis is a technique to look at the correlation between two or more variables and then estimation become a model that can be an equation that can connect the dependent variable of the independent variable. Many paper non-parametric regression estimation for efficiency in production on the independent variables in certain procedures to explain the factors that may affect the performance of the dependent variable. The regression model that handles these situations requires a set of equations (one single equation alone is not enough) that need to be solved simultaneously and this model is known as econometric models. In addition, conventional approaches to inference used in this paper is invalid because an elaborate serial correlation, unknown among the estimated efficiencies. Authors first describe a decent data for models like this.

The mathematical equations that allow to forecast the values of a dependent variable of one or more independent variables called the regression equation. The term is derived from the results of observations made Sir Francis Galton (1822 - 1911) that compares the height of a boy with his father's height. Galton states that the height of the boys from the father high on several generations later tended to "regressed" close to the average population.

Watson (1937) uses a regression of leaf area to estimate the average extent in a factory. The procedure is to weigh the whole leaves of the plant. For a small sample of the leaves, broad and weight of each leaf has been set. On average regression on the weight of the leaves, the core of the application is that the weight of the leaves can be found quickly but the determination is time consuming.

II. DISCUSSION

The muptiple linear regression model can be expressed as $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots . + \beta_m x_m + \mathcal{E}$ The$\beta_0, \beta_1, \beta_2, \ldots . \beta_m$ can be estimated by the least square approximation as long as the model is linear in the $\beta_0, \beta_1, \beta_2, \ldots . \beta_m$

We have n observation, with this equation

$$y_1 = \beta_0 + \beta_1 x_{11} + \beta_2 x_{12} + \beta_3 x_{13} + \cdots + \beta_m x_{1m} + \varepsilon_1$$

$$y_2 = \beta_0 + \beta_1 x_{21} + \beta_2 x_{22} + \beta_3 x_{23} + \cdots + \beta_m x_{2m} + \varepsilon_2$$

$$y_3 = \beta_0 + \beta_1 x_{31} + \beta_2 x_{32} + \beta_3 x_{33} + \cdots + \beta_m x_{3m} + \varepsilon_3$$

$$\vdots$$

$$y_{n-1} = \beta_0 + \beta_1 x_{(n-1)1} + \beta_2 x_{(n-1)2} + \beta_3 x_{(n-1)3} + \cdots + \beta_m x_{(n-1)m} + \varepsilon_{(n-1)})$$

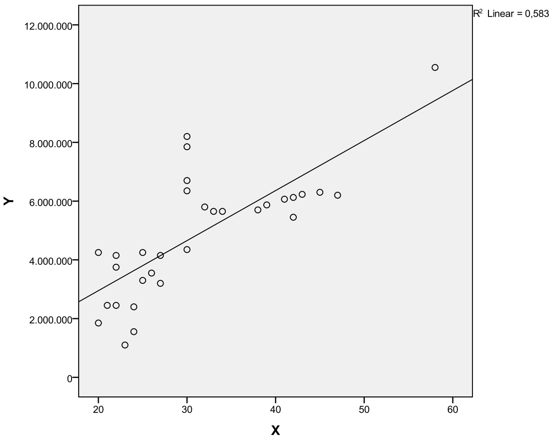
$$y_n = \beta_0 + \beta_1 x_{n1} + \beta_2 x_{n2} + \beta_3 x_{n3} + \cdots + \beta_m x_{nm} + \varepsilon_n$$

We can show thats equation in matrix formula $y = X\beta + \varepsilon$

With $y = \begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ \vdots \\ y_{n-1} \\ y_n \end{pmatrix}$, $\mathcal{E} = \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \vdots \\ \varepsilon_{n-1} \\ \varepsilon_n \end{pmatrix}$and than $X = \begin{pmatrix} 1 & x_{11} & x_{12} & \cdots & x_{1m} \\ 1 & x_{21} & x_{22} & \cdots & x_{2m} \\ 1 & x_{31} & x_{32} & \cdots & x_{3m} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ 1 & x_{n1} & x_{n2} & \cdots & x_{nm} \end{pmatrix}$

Estimator of β

For the all of parameter $\beta_0, \beta_1, \beta_2, \ldots . \beta_m$ and for minimize the sum of square of deviations in an observation we can predict value of $\hat{y}$ with $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \ldots ., \hat{\beta}_m$ so we can use equation $y_1 = \beta_0 + \beta_1 x_{11} + \beta_2 x_{12} + \beta_3 x_{13} + \cdots + \beta_m x_{1m} + \varepsilon_1$ until $y_n = \beta_0 + \beta_1 x_{n1} + \beta_2 x_{n2} + \beta_3 x_{n3} + \cdots + \beta_m x_{nm} + \varepsilon_n$ with the equation $\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \hat{\beta}_2 x_{i2} + \hat{\beta}_3 x_{i3} + \cdots + \hat{\beta}_m x_{im}$



the linear line $\hat{y}$ shows the distribution of the dots indicate y, so it can be seen that $\hat{y} = \varepsilon + y$ in other words $\varepsilon = \hat{y} - y$ withdrawal procedure known regression line is the least squares method (ordinary least squares) or better known with the term OLS. This method choose a regression line to make the sum of squared vertical distances of the points through which the straight line as small as possible, whereby if the multiple linear regression model of the population is $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots . + \beta_m x_m + \mathcal{E}$ where as the estimation model of multiple linear regression is $\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \hat{\beta}_2 x_{i2} + \hat{\beta}_3 x_{i3} + \cdots + \hat{\beta}_m x_{im}$ so meaning OLS estimates on multiple linear regression there are:

Population regression equation : $y = X\hat{\beta} + \varepsilon$

Residual (estimate of random error) : $\varepsilon = y - X\hat{\beta}$

Sum of Squares Error (SSE) : $\hat{\varepsilon}'\hat{\varepsilon} = (y - X\hat{\beta})'(y - X\hat{\beta})$

$= y'y - 2\hat{\beta}'y + \hat{\beta}'X'X\hat{\beta}$

minimize SSE : $\frac{\partial(\hat{\varepsilon}'\hat{\varepsilon})}{\partial\hat{\beta}} = -2X'y + 2X'X\hat{\beta} = 0$

Estimator OLS : $\hat{\beta} = (X'X)^{-1}X'y$

Least square estimation for $\hat{\beta}$

From estimation OLS $\hat{\beta} = (X'X)^{-1}X'y$ if $E(y) = X\beta$ then $\hat{\beta}$ is an unbiased estimator for β so we can show that $E(\hat{\beta}) = E((X'X)^{-1}X'y)$

$E(\hat{\beta}) = (X'X)^{-1}X'E(y)$=β

III. CONCLUSION

Linear regression estimates were made to improve the accuracy by using additional variables that correlated with. When y_i the relationship between x_i and y_i tested, it was found that although the relationship may be a linear approach, the line is not via the point of origin. These results suggest an estimate based on a linear regression of the y_i from x_i better than the ratio of two variables.

Estimated regression is consistent, in simple terms when the sample consists of all units of the population $\bar{x} = \bar{X}$ and reduce the regression estimates $\bar{Y}$. As will be shown, in general regression estimates are biased, but the ratio of the bias is to the standard error becomes smaller when large samples.

With an appropriate choose of β , regression estimates included as special cases on average per unit and the estimated ratio, when β taken equal to zero, y_i reducing $\hat{y}$ but if $\beta = \frac{\bar{y}}{\bar{x}}$, so $\hat{y} = \bar{y} + \beta(\bar{X} - \bar{x}) = \bar{y} + \frac{\bar{y}}{\bar{x}}(\bar{X} - \bar{x}) = \hat{\bar{Y}}$

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M – 29

COMPUTING GENERATOR OF SECOND HOMOTOPY MODULE $\langle a, b; a^p, b^q, aba^{-1}b^{-1}\rangle$ AND $\langle t; t^{pq}\rangle$ USING TIETZE TRANSFORMATION METHODS

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Abstract—This article discuss about presentation group $\langle a, b; a^p, b^q, aba^{-1}b^{-1}\rangle$ and $\langle t; t^{pq}\rangle$. It is shown that these presentations are isomorphism and there is process to compute generator of second homotopy module from $\pi_2(\langle a, b; a^p, b^q, aba^{-1}b^{-1}\rangle)$ to $\pi_2(\langle t; t^{pq}\rangle)$. This computation using Tietze transformation and operation on picture.

Keywords: *presentation group, second homotopy module, generator, Tietze transformation*

I. INTRODUCTION

Group are very often described as quotient group of free group: $G = F/N$. If F is free with base $\boldsymbol{x}$ and N is normal closure in F of a set $\boldsymbol{r}$, we say that the pair $\langle \boldsymbol{x}; \boldsymbol{r}\rangle$ is a *presentation*,. Set $\boldsymbol{x}$ is *defining generator* of G and set $\boldsymbol{r}$ is *defining relations*. The element of $\boldsymbol{r}$ will be called relator.
A presentation $\langle \boldsymbol{x}; \boldsymbol{r}\rangle$ is finitely generated if $\boldsymbol{x}$ is finite, and is finitely related if $\boldsymbol{r}$ is finite. A presentation $\langle \boldsymbol{x}; \boldsymbol{r}\rangle$ is finite if both of $\boldsymbol{x}$ and $\boldsymbol{r}$ are finite, in this case $\langle \boldsymbol{x}; \boldsymbol{r}\rangle$ is finitely presented. There are some alterations one can make to a presentation which result in presentations of a group isomorphic to the original. These are called Tietze transformations. Let $\mathcal{P} = \langle \boldsymbol{x}; \boldsymbol{r}\rangle$ so we have *first fundamental group* $(\pi_1(\mathcal{P}))$ and *second homotopy module* $((\pi_2(\mathcal{P}))$ of presentation group. Therefore this article discuss about second homotopy module. The element of second homotopy module is equivalence class of spherical picture.

II. PRELIMINARIES

We review some definitions and results that we will use to solve the main result of this article.

Definition 2.1 (Definition of Tietze Transformation) ([3], [5]) *Let* $\mathcal{P}_1 = \langle \boldsymbol{x}\,; \boldsymbol{r}\rangle$ *and* $\mathcal{P}_2 = \langle \boldsymbol{y}\,; \boldsymbol{s}\rangle$ *be two presentations of the group* G.

(*T1*) *If the word S is derivable from* $\boldsymbol{r}$, *then add S to the list of relators;* $\langle \boldsymbol{x}\,; \boldsymbol{r}\rangle \to \langle \boldsymbol{x}\,; S, \boldsymbol{r}\rangle$

(*T2*) *If the word S is derivable from* $\boldsymbol{r}$, *remove S from the list relators;* $\langle \boldsymbol{x}\,; S, \boldsymbol{r}\rangle \to \langle \boldsymbol{x}\,; \boldsymbol{r}\rangle$

(*T3*) *If R is word in the* $\boldsymbol{x}$, *and y is some symbol not in the generating set, add y to the generating set and add word* $y^{-1}R \in \boldsymbol{r}$, $y \in \boldsymbol{x}$ *to the relator set.*

(*T4*) *If there is a relator of the form* $y^{-1}R \in \boldsymbol{r}$, $y \in \boldsymbol{x}$ *with y not appearing in R, delete this relator and delete y from the generating set, replacing all order occurences of y in the relator words with* R.

Theorem 2.2 ([5]) *Suppose that the groups presented by the two presentations* $\langle \boldsymbol{x}; \boldsymbol{r}\rangle$ *and* $\langle \boldsymbol{y}; \boldsymbol{s}\rangle$ *are isomorphic. Then there is a sequence of Tietze transformations leading from one of these to the other. If these presentations are both finite the sequence can be taken to be a finite number of single step.*

Definition 2.3 ([6]) *A picture* $\mathbb{P}$ *over* $\mathcal{P}$ *is a geometric configuration consisting of of the following:*

a. *A disc D^2 with basepoint O on ∂D^2.*
b. *Disjoint discs $\Delta_1, \Delta_2, \dots, \Delta_n$ in the interior of D^2. Each Δ_i has a basepoint O_i on $\partial\Delta_i$.*
c. *A finite number of disjoint arcs $\alpha_1, \alpha_2, \dots, \alpha_m$ where each arc lies in the closure of $D^2 - \bigcup_{i=1}^{n}\Delta_i$ and is either simple closed curve having trivial intersection with $\partial D^2 \cup (\bigcup_{i=1}^{n}\partial\Delta_i)$, or is a simple non-closed curve which join two points of $\partial D^2 \cup (\bigcup_{i=1}^{n}\partial\Delta_i)$, neither point being a basepoint. Each arc has a normal orientation, indicated by a short arrow meeting with the arc transversely and is labelled by an element of $\boldsymbol{x} \cup \boldsymbol{x}^{-1}$.*
d. If we travel around $\partial\Delta_i$ once in clockwise direction starting from O_i and read off the labels on arcs encountered (if we cross an arc, labelled x say, in the direction of its normal orientation, then we read x^{-1}), then we obtain a word which belongs to $\boldsymbol{r} \cup \boldsymbol{r}^{-1}$. We call this word the label of Δ_i.

Definition 2.4 ([6]) *A picture $\mathbb{P}$ over $\mathcal{P} = \langle \boldsymbol{x}; \boldsymbol{r}\rangle$ is a spherical picture if all arcs in $\mathbb{P}$ do not touch the boundary disc.*

Two spherical pictures $\mathbb{P}_1$ and $\mathbb{P}_2$ are said to be *equivalent* if either: (a) both are spherical and one can be transformed to the other by a finite number of operation deletion and insertion floating circle, deletion and insertion folding pair and bridge move; or (b) both are not spherical and one can be transformed to the other by a finite number of operation deletion and insertion floating circle, deletion and insertion semicircle, deletion and insertion folding pair and bridge move. Base on [1], A set $\boldsymbol{P}$ of spherical picture over $\mathcal{P} = \langle \boldsymbol{x}; \boldsymbol{r}\rangle$ is called a set of generator $\pi_2(\mathcal{P})$ if $\{[\mathrm{P}]:\mathrm{P} \in \boldsymbol{P}\}$ generate $\mathbb{Z}G$ $-$module. Base on [2], set generator $\boldsymbol{P}$ is generator iff each spherical picture over $\mathbb{P}$ can be transformated to empty picture by using operation on picture.

III. THE MAIN RESULT

We consider presentation group $\langle a, b; a^p, b^q, aba^{-1}b^{-1}\rangle$ and $\langle t; t^{pq}\rangle$. It is shown that these presentation are isomorphic using Tiestze transformation.

Note that, if p and q nonzero integer, there are integer m and n such that $mp + nq = \gcd(p, q)$. Since p and q are prime relative, so $\gcd(p, q) = 1 = mp + \_nq$..

Tietze transformation of $\langle a, b; a^p, b^q, aba^{-1}b^{-1}\rangle$ to $\langle t; t^{pq}\rangle$.

$\langle a, b; a^p, b^q, aba^{-1}b^{-1}\rangle$

$\xrightarrow{T3} \langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m\rangle$

Add generator t in to set of generator with relation $t = a^n b^m$.

$\xrightarrow{T1} \langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq}\rangle$

Add t^{pq} in to set of relation, since derived from $t = a^n b^m$, $a^p = 1$, and $b^q = 1$, that is $t^{pq} = (a^n b^m)^{pq} = a^{npq} b^{mpq} = 1$.

$\xrightarrow{T1} \langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq}, a = t^q\rangle$

Add relator $a = t^q$ since derived from :

$$\begin{aligned} t^q &= (a^n b^m)^q \\ &= a^{nq} b^{mq} \\ &= a^{nq} \text{ since } b^q = 1 \\ &= a^{1-mp} \text{ since } mp + nq = 1 \\ &= aa^{-mp} = a \text{ since } a^p = 1 \end{aligned}$$

$\xrightarrow{T1} \langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq}, a = t^q, b = t^p\rangle$

Add relator $b = t^p$ since derived from:

$$\begin{aligned} t^p &= (a^n b^m)^p \\ &= a^{np} b^{mp} \\ &= b^{mp} \text{ since } a^p = 1 \\ &= b^{1-mq} \text{ since } mp + nq = 1 \\ &= bb^{-mq} \\ &= b \text{ since } b^q = 1 \end{aligned}$$

$\xrightarrow{T2} \langle a, b, t; a^p, b^q, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle$

Delete $aba^{-1}b^{-1}$ from set of relations, since $a = t^q$ and $b = t^p$, so we have $1 = t^q t^p t^{-q} t^{-p} = aba^{-1}b^{-1}$.

$\xrightarrow{T2} \langle a, b, t; b^q, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle$

Delete a^p from set of relations, since t^{pq} and $a = t^q$ so we have $a^p = (t^q)^p = t^{pq} = 1$.

$\xrightarrow{T2} \langle a, b, t; t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle$

Delete b^q from set of relations, since t^{pq} and $b = t^p$ so we have $b^q = (t^p)^q = t^{pq} = 1$.

$\xrightarrow{T2} \langle a, b, t; t^{pq}, a = t^q, b = t^p \rangle$

Delete relator $t = a^n b^m$ since derived from $a = t^q, b = t^p$ and $t^{pq} = 1$, that is :
$t = t^{mp+nq} = t^{mp} t^{nq} = a^n b^m$

$\xrightarrow{T4} \langle b, t; t^{pq}, b = t^p \rangle$

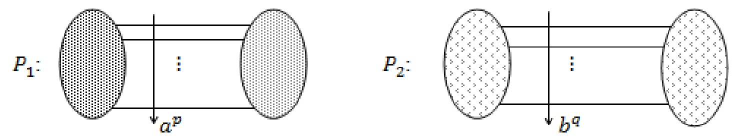
Delete generator a from set of generators

$\xrightarrow{T4} \langle t; t^{pq} \rangle$

Delete generator b from set of generators

So we have $\langle a, b; a^p, b^q, aba^{-1}b^{-1} \rangle \cong \langle t; t^{pq} \rangle$.

Base on [2] we have generators of $\pi_2(\langle a, b; a^p, b^q, aba^{-1}b^{-1} \rangle)$ are spherical picture containing discs a^p, b^q, a^p and $aba^{-1}b^{-1}$; and spherical picture containing discs b^q and disc $aba^{-1}b^{-1}$. We say that generators are P_1, P_2, P_3 dan P_4 , respectively, i. e:



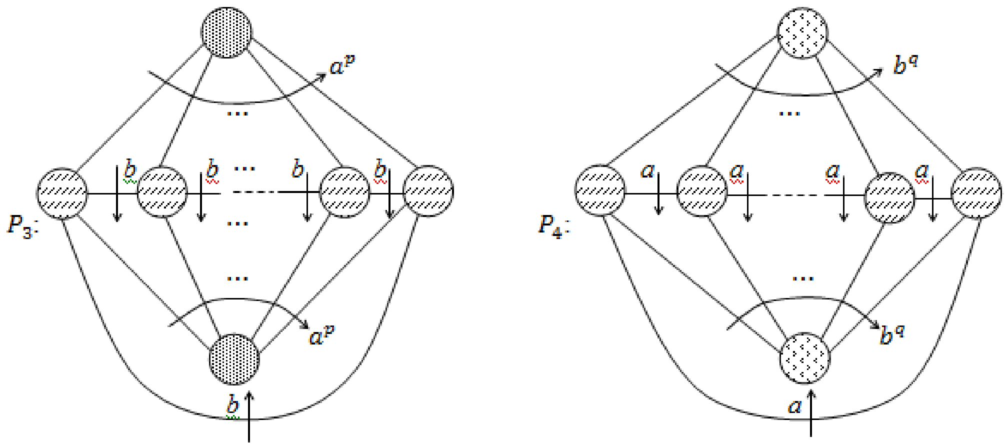


Figure 1: The generator of $\pi_2(\langle a, b; a^p, b^q, aba^{-1}b^{-1} \rangle)$

Whereas generator of $\pi_2(\langle t; t^{pq} \rangle)$ is spherical picture containing disc t^{pq}, that is

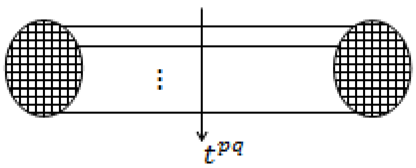


Figure 2: The generator of $\pi_2(\langle t; t^{pq} \rangle)$

Furthermore, we use Theorem 1, Theorem 2, Corrolari 1 and Corrolari 2 on [7] to compute generator of second homotopy module of each presentation, i.e:

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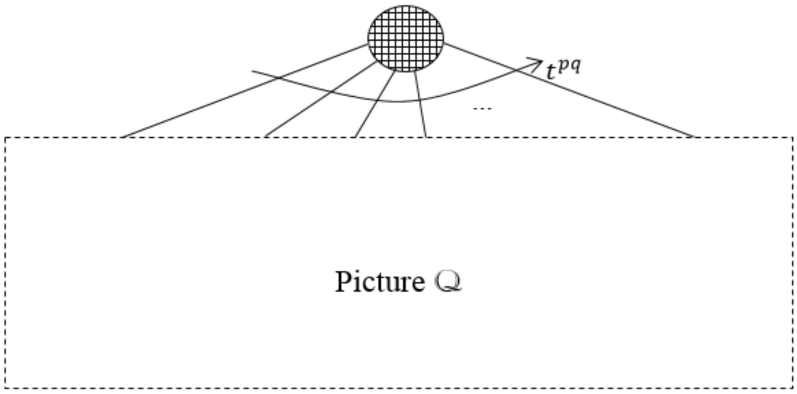
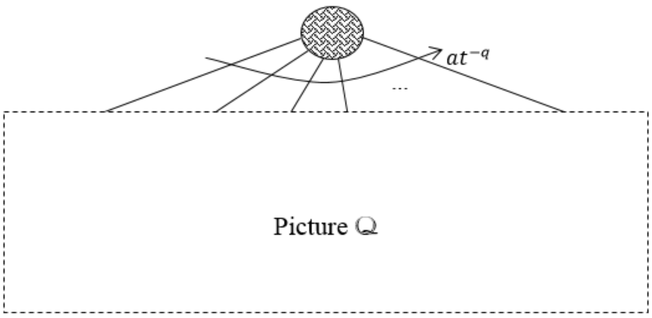
1. $\xrightarrow{T3} \langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m \rangle$
   Generators of $\pi_2(\langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m \rangle)$ equal to generator of $\pi_2(\langle a, b; a^p, b^q, aba^{-1}b^{-1} \rangle)$, that is, P_1, P_2, P_3 dan P_4.

2. $\xrightarrow{T1} \langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq} \rangle$
   Generators of $\pi_2(\langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq} \rangle)$ are P_1, P_2, P_3, P_4 and P_5 , which P_5 is generator containing disc t^{pq},



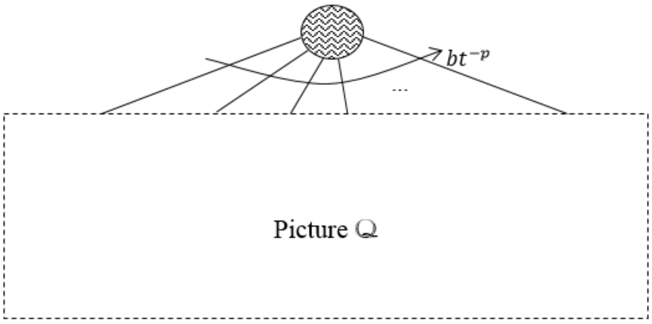
and $\mathbb{Q}$ is picture containing discs $a^n b^m$, a^p, b^p and $aba^{-1}b^{-1}$.

3. $\xrightarrow{T1} \langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq}, a = t^q \rangle$
   Generators of $\pi_2(\langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq}, a = t^q \rangle)$ are P_1, P_2, P_3, P_4, P_5 dan P_6, which P_6 is generator containing disc at^{-q}, that is



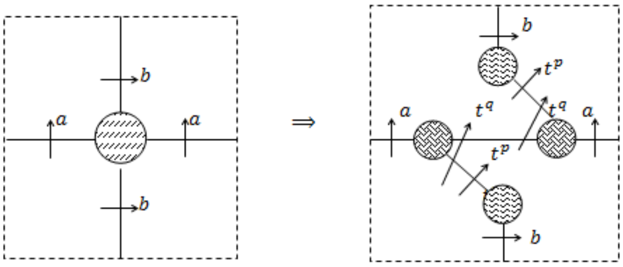
and $\mathbb{Q}$ is picture containing discs $a^n b^m$, b^p and $aba^{-1}b^{-1}$.

4. $\xrightarrow{T1} \langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle$
   Generators of $\pi_2(\langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle)$ are $P_1, P_2, P_3, P_4, P_5, P_6$ and P_7, which P_7 is generator containing disc $b = t^p$,

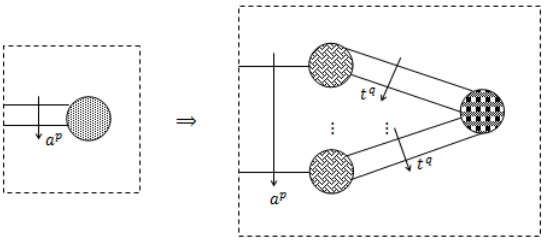


and $\mathbb{Q}$ is picture containing discs $a^n b^m$, a^p and $aba^{-1}b^{-1}$.

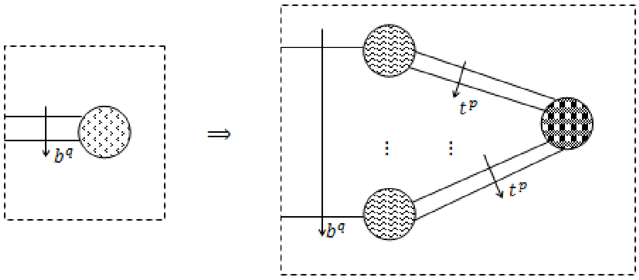
5. $\xrightarrow{T2} \langle a, b, t; a^p, b^q, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle$
On $\pi_2(\langle a, b, t; a^p, b^q, aba^{-1}b^{-1}, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle)$ there is a deletion disc $aba^{-1}b^{-1}$ and replace arc a be t^q and arc b be t^p. So, generators containing disc $aba^{-1}b^{-1}$ will be changed, as seen below:



6. $\xrightarrow{T2} \langle a, b, t; b^q, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle$
On $\pi_2(\langle a, b, t; a^p, b^q, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle)$ there are deletion of disc a^p. The generators containing disc a^p will be changed, as seen below:

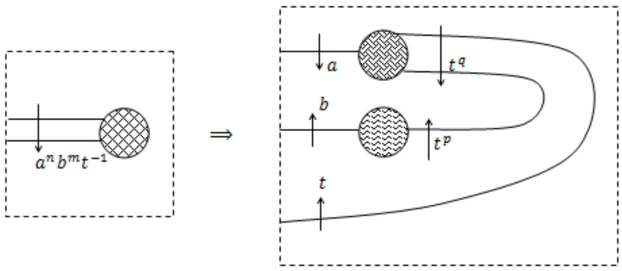


7. $\xrightarrow{T2} \langle a, b, t; t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle$
On $\pi_2(\langle a, b, t; b^q, t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle)$ there is a deletion of disc b^q The generators containing disc b^q will be changed, as seen below:



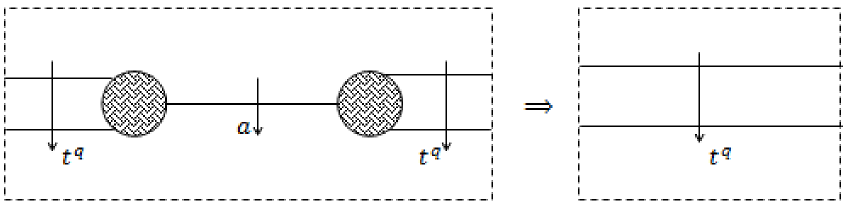
8. $\xrightarrow{T4} \langle a, b, t; t^{pq}, a = t^q, b = t^p \rangle$

On $\pi_2(\langle a, b, t; t = a^n b^m, t^{pq}, a = t^q, b = t^p \rangle)$ there is a deletion $t = a^n b^m$. The generators containing disc $t = a^n b^m$ ($t = a^n b^m \Leftrightarrow a^n b^m t^{-1}$) will be changed, as seen below:



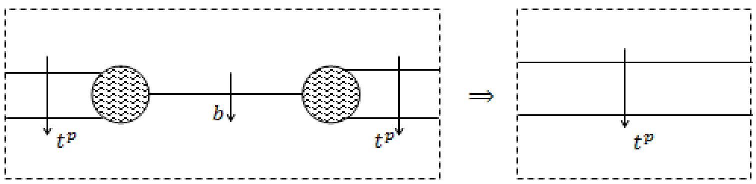
9. $\xrightarrow{T4} \langle b, t; t^{pq}, b = t^p \rangle$

On $\pi_2(\langle a, b, t; t^{pq}, a = t^q, b = t^p \rangle)$ there is deletion generator a. The generators containing disc a will be changed, as seen below:

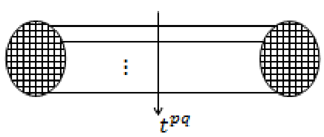


10. $\xrightarrow{T4} \langle t; t^{pq} \rangle$

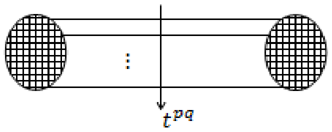
On $\pi_2(\langle b, t; t^{pq}, b = t^p \rangle)$ there is deletion generator b. The generators containing disc b will be changed, as seen below:



Finally, we have generator containing disc t^{pq}, that is:



Thus, generaotos of $\pi_2(\langle t; t^{pq} \rangle)$ is



IV. EXAMPLE

Consider group presentation $\langle a,b;a^2,b^3,aba^{-1}b^{-1}\rangle$ and $\langle t;t^{2.3}\rangle=\langle t;t^6\rangle$. Remember that 2 and 3 are relatively prime, so there are integers m and n such that $2m+3n=1$. Let $m=-1$ and $n=1$.

Tietze transformation from $\langle a,b;a^2,b^3,aba^{-1}b^{-1}\rangle$ to $\langle t;t^6\rangle$.

$\langle a,b;a^2,b^3,aba^{-1}b^{-1}\rangle$

$\xrightarrow{T3}\langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1}\rangle$

$\xrightarrow{T1}\langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6\rangle$

$\xrightarrow{T1}\langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6,a=t^3\rangle$

$\xrightarrow{T1}\langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6,a=t^3,b=t^2\rangle$

$\xrightarrow{T2}\langle a,b,t;a^2,b^3,t=ab^{-1},t^6,a=t^3,b=t^2\rangle$

$\xrightarrow{T2}\langle a,b,t;b^3,t=ab^{-1},t^6,a=t^3,b=t^2\rangle$

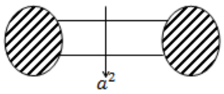
$\xrightarrow{T2}\langle a,b,t;t=ab^{-1},t^6,a=t^3,b=t^2\rangle$

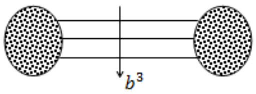
$\xrightarrow{T4}\langle a,b,t;t^6,a=t^3,b=t^2\rangle$

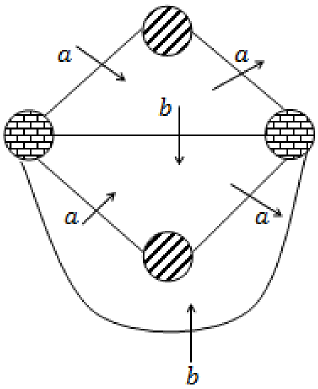
$\xrightarrow{T4}\langle b,t;t^6,b=t^2\rangle$

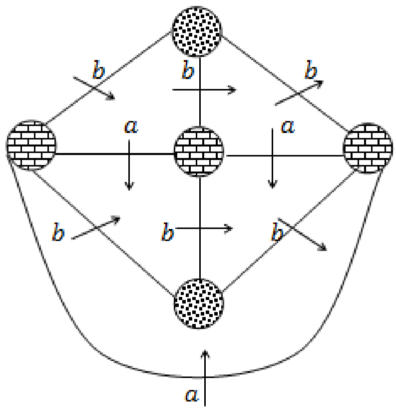
$\xrightarrow{T4}\langle t;t^6\rangle$

We have four generators of $\pi_2(\langle a,b;a^2,b^3,aba^{-1}b^{-1}\rangle)$, that is:

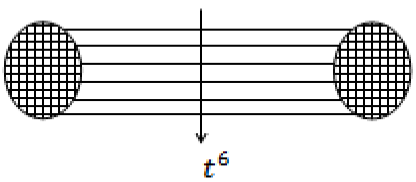
P_1:


P_2:


P_3:


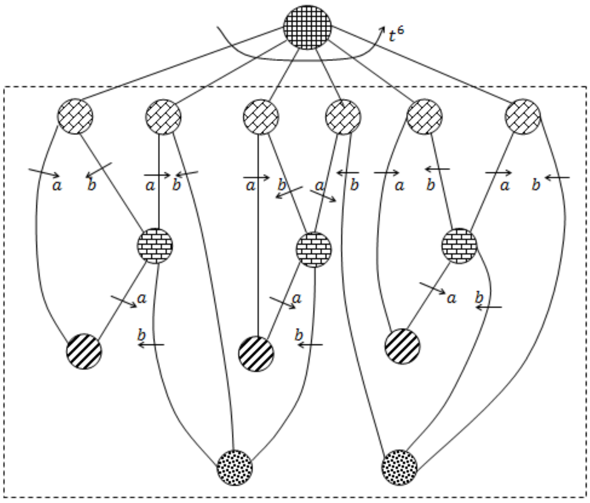
P_4:


Meanwhile, generator of $\pi_2(\langle t;t^6\rangle)$ is

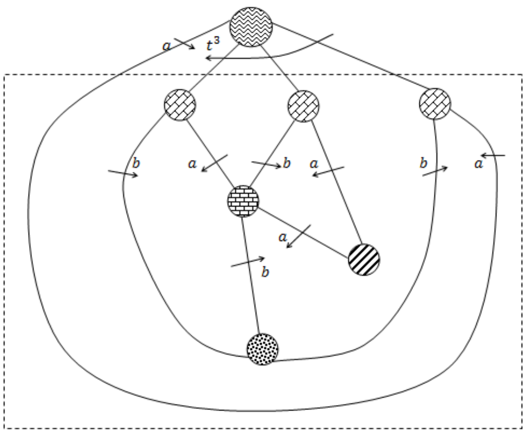


Next, will be shown the process of changing generators of $\pi_2(\langle a,b;a^2,b^3,aba^{-1}b^{-1}\rangle)$ to $\pi_2(\langle t;t^6\rangle)$:

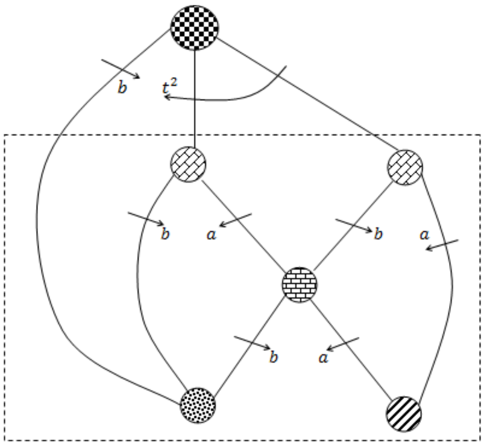
1. $\xrightarrow{T3} \langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1}\rangle$
   The generators of $\pi_2(\langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1}\rangle)$ are P_1, P_2, P_3 and P_4.
2. $\xrightarrow{T1} \langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6\rangle$
   The generators of $\pi_2(\langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6\rangle)$ are P_1, P_2, P_3, P_4 and P_5, where P_5 is



3. $\xrightarrow{T1} \langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6,a=t^3\rangle$
   The generators of $\pi_2(\langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6,a=t^3\rangle)$ are P_1, P_2, P_3, P_4, P_5 and P_6, where P_6 is

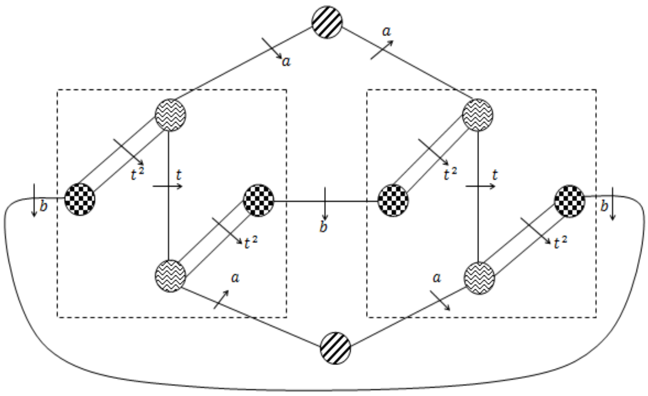


4. $\xrightarrow{T1} \langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6,a=t^3,b=t^2\rangle$
   The generators of $\pi_2(\langle a,b,t;a^2,b^3,aba^{-1}b^{-1},t=ab^{-1},t^6,a=t^3,b=t^2\rangle)$ are P_1, P_2, P_3, P_4, P_5, P_6 and P_7, where P_7 is

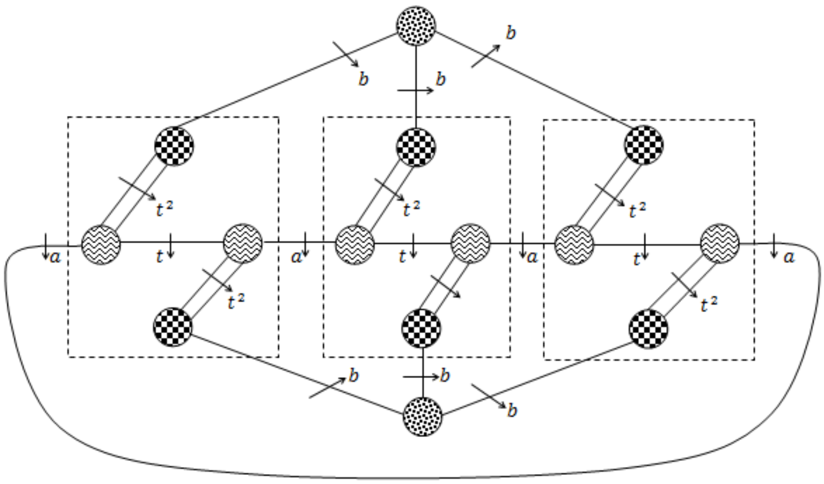


5. $\xrightarrow{T2} \langle a, b, t; a^2, b^3, t = ab^{-1}, t^6, a = t^3, b = t^2 \rangle$
Generators P_3, P_4, P_5, P_6 and P_7 containing $aba^{-1}b^{-1}$ will be changed, and each one is named $P_3{}'$, $P_4{}'$, $P_5{}'$, $P_6{}'$ and $P_7{}'$.

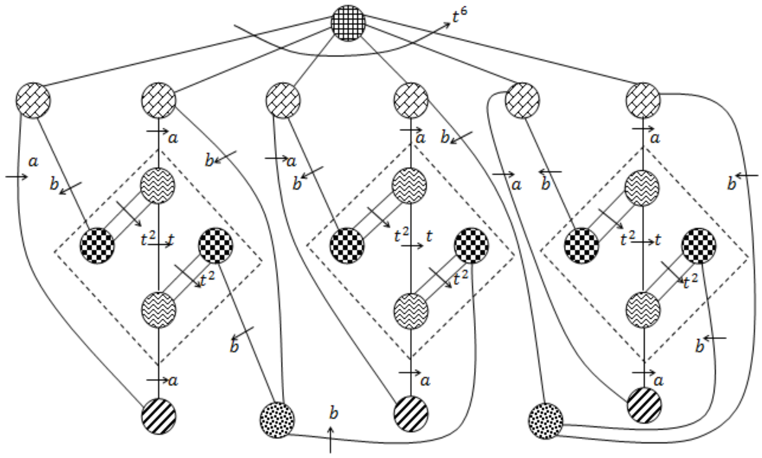
$P_3{}'$:



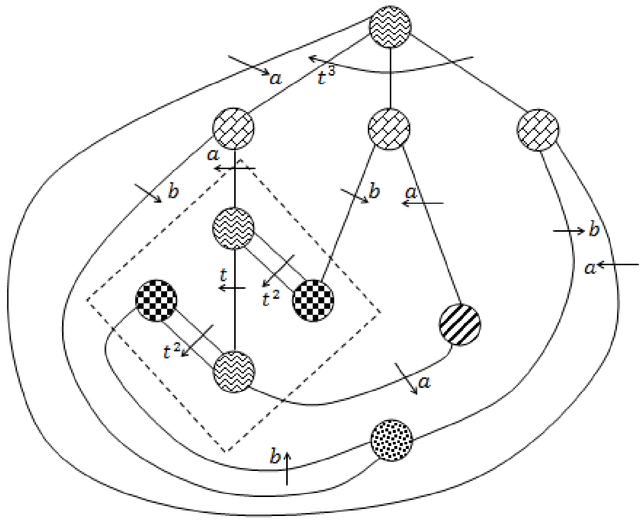
$P_4{}'$:



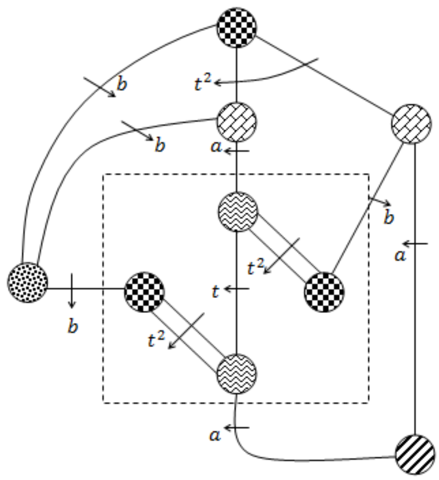
$P_5{}'$:



$P_6{}'$:



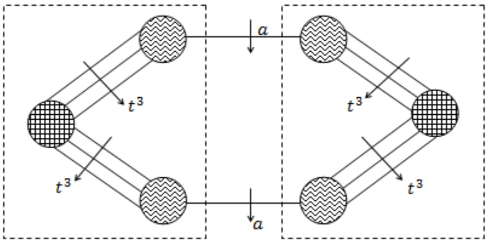
$P_7{}'$:



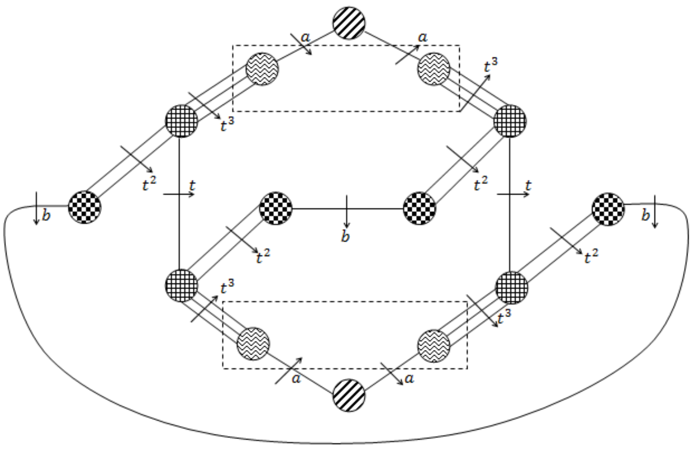
Generators of $\pi_2(\langle a, b, t; a^2, b^3, t = ab^{-1}, t^6, a = t^3, b = t^2\rangle)$ are P_1, P_2, $P_3{}'$, $P_4{}'$, $P_5{}'$, $P_6{}'$ dan $P_7{}'$.

6. $\xrightarrow{T2} \langle a, b, t; b^3, t = ab^{-1}, t^6, a = t^3, b = t^2 \rangle$
Generators containing a^2 are P_1, $P_3{}'$, $P_5{}'$, $P_6{}'$ and $P_7{}'$ will be changed and each one is named $P_1{}'$, $P_3{}''$, $P_5{}''$, $P_6{}''$ dan $P_7{}''$.

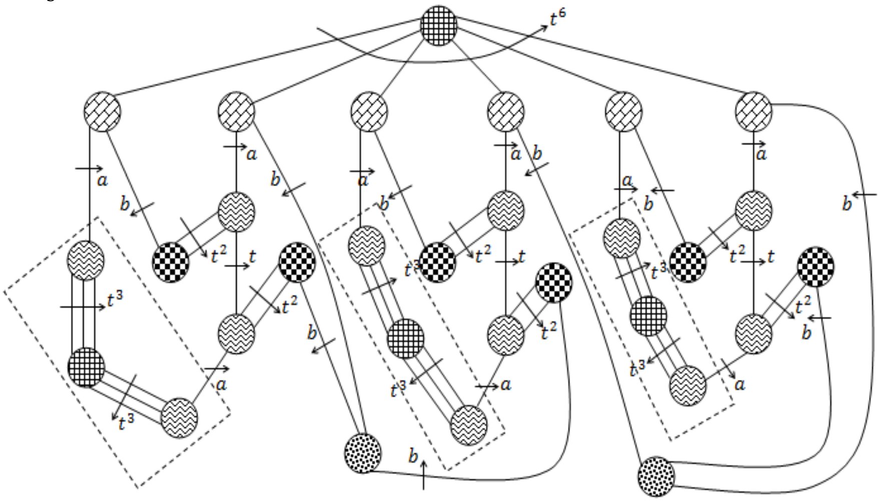
$P_1{}'$:



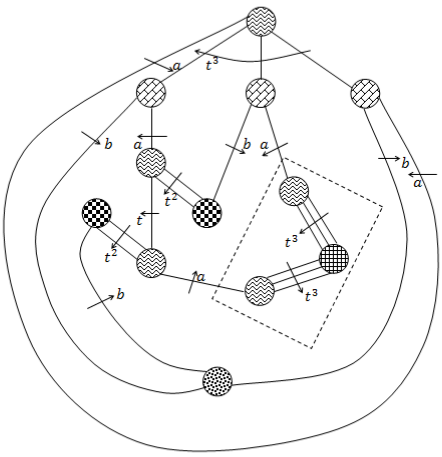
$P_3{}''$:



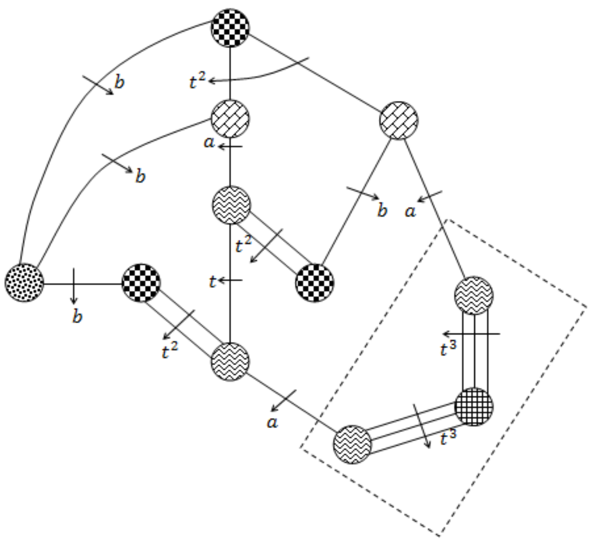
P_5'':



P_6'' :



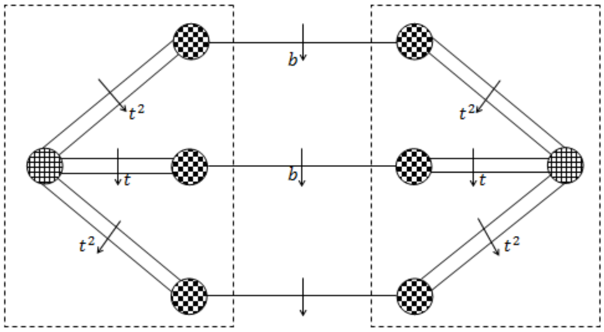
P_7'' :



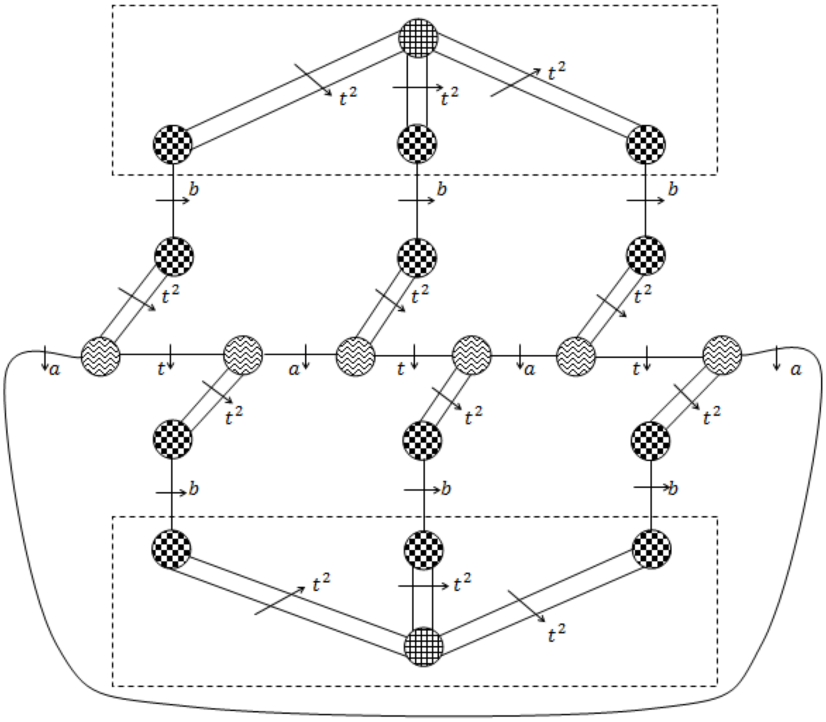
Generators of $\pi_2(\langle a,b,t;b^3,t=ab^{-1},t^6,a=t^3,b=t^2\rangle)$are P_1', P_2, P_3'', P_4' P_5'', P_6'' and P_7''.

7. $\xrightarrow{T2}\langle a,b,t;t=ab^{-1},t^6,a=t^3,b=t^2\rangle$
Generators P_2, P_4', P_5'', P_6'' and P_7'' will be changed and each one is named P_2', P_4'', P_5^*, P_6^* dan P_7^*.

P_2':



P_4'':



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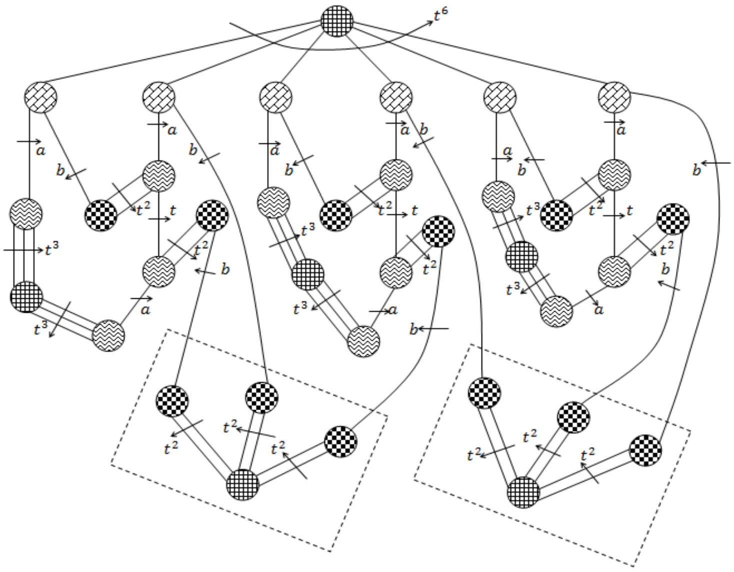
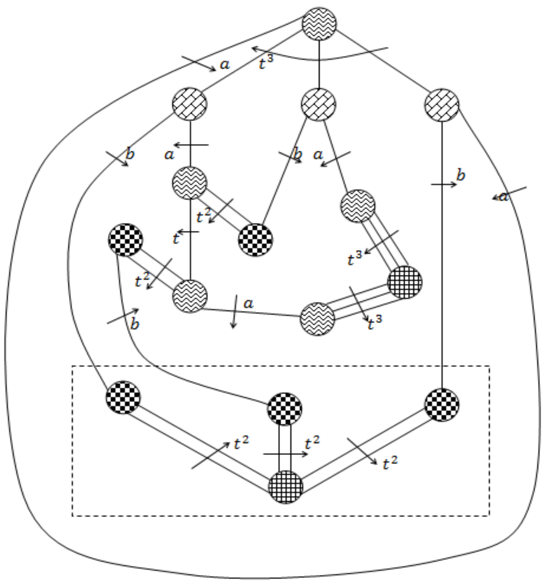
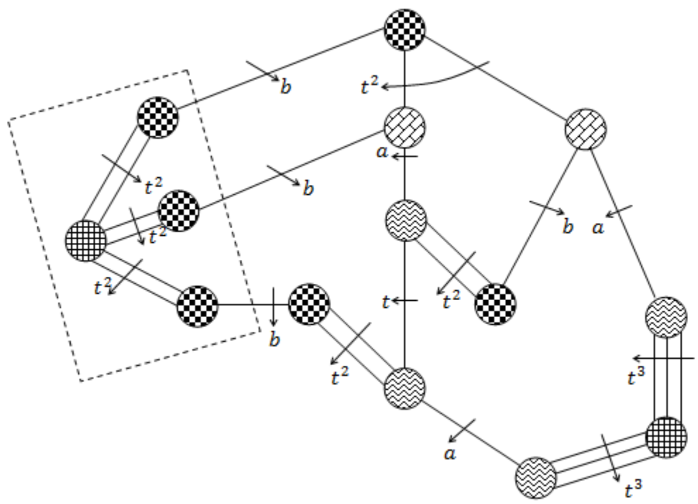
$P_5{}^*$:



$P_6{}^*$:



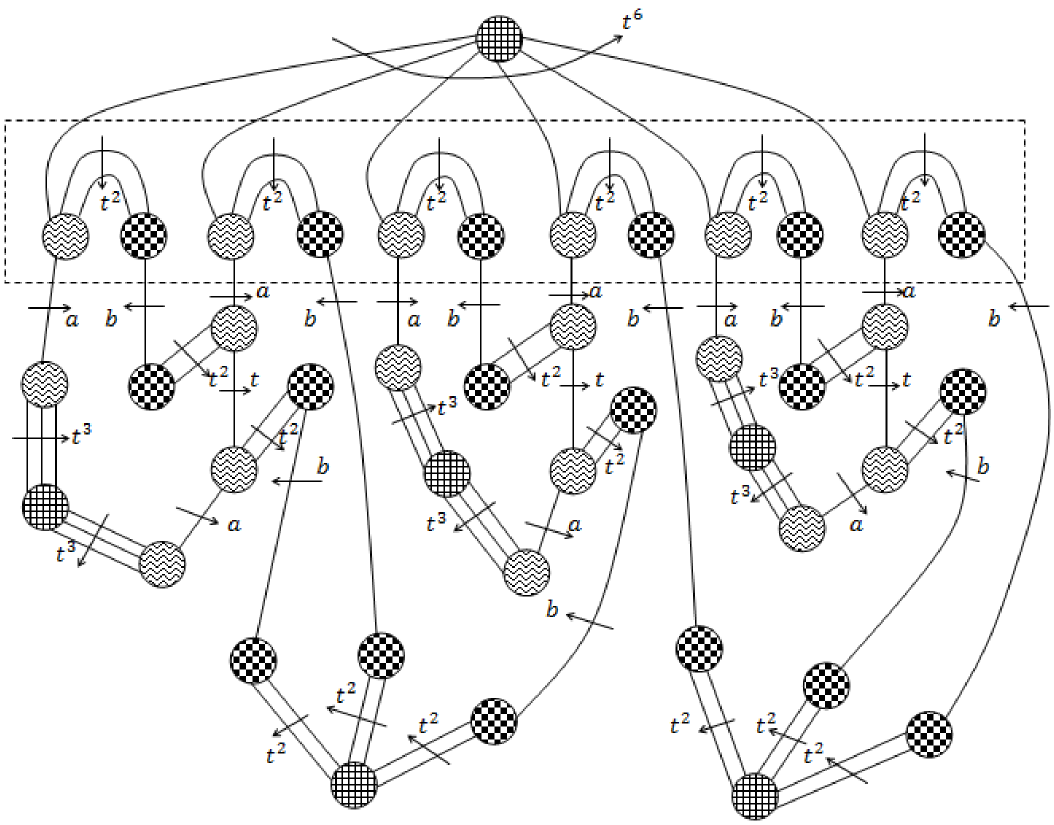
${P_7}^*$:



Generators of $\pi_2(\langle a,b,t; t=ab^{-1}, t^6, a=t^3, b=t^2\rangle)$ are ${P_1}'$, ${P_2}'$, ${P_3}''$, ${P_4}''$, ${P_5}^*$,dan ${P_6}^*$.

8. $\xrightarrow{T4} \langle a,b,t; t^6, a=t^3, b=t^2\rangle$
Generators ${P_5}^*$, ${P_6}^*$ and ${P_7}''$ will be changed and each one is named ${P_5}^{**}$, ${P_6}^{**}$ dan ${P_7}^*$.

${P_5}^{**}$:



${P_6}^{**}$:

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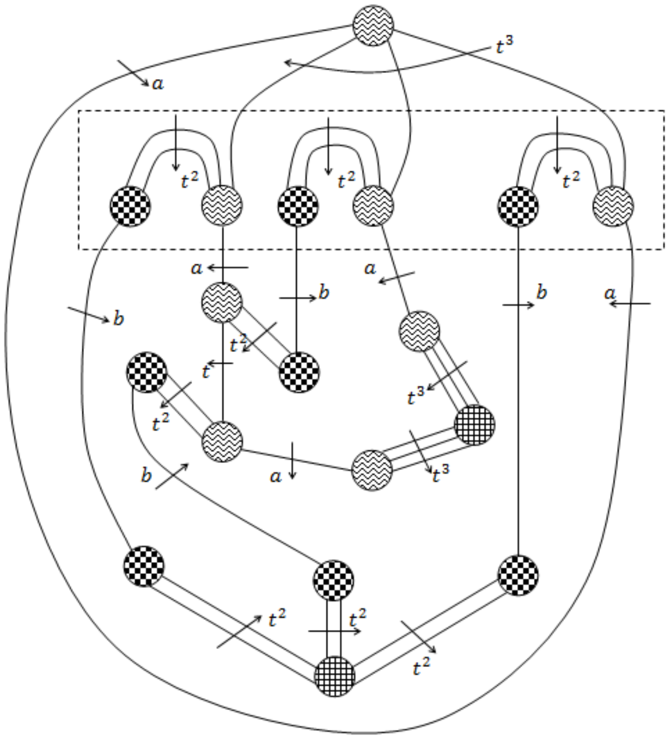
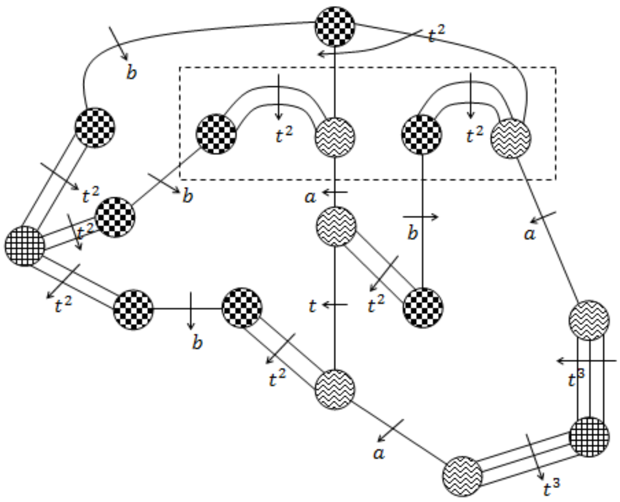


$P_7{}^{**}$:

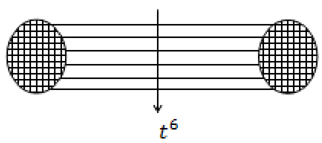


Generators of $\pi_2(\langle a, b, t; t^6, a = t^3, b = t^2\rangle)$ are $P_1{}'$, $P_2{}'$, $P_3{}''$, $P_4{}''$, $P_5{}^{**}$, $P_6{}^{**}$ dan $P_7{}^{**}$.

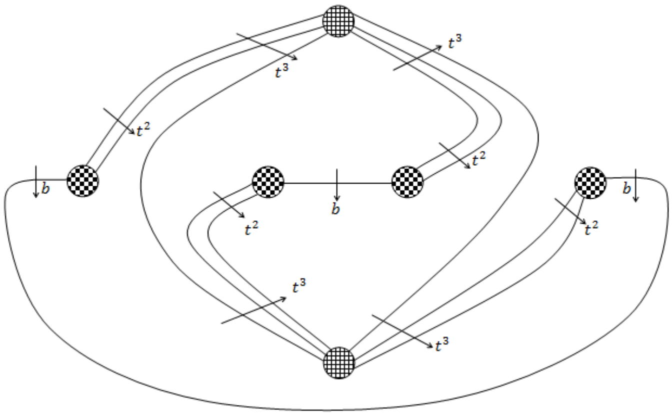
9. $\xrightarrow{T4} \langle b, t; t^6, b = t^2\rangle$

Generators $P_1{}'$, $P_3{}''$, $P_4{}''$, $P_5{}^{**}$, $P_6{}^{**}$ and $P_7{}^{**}$ will be changed and each one is named $P_1{}''$, $P_3{}^{*}$ $P_4{}^{*}$, $P_5{}^{\wedge}$, $P_6{}^{\wedge}$ dan $P_7{}^{\wedge}$.

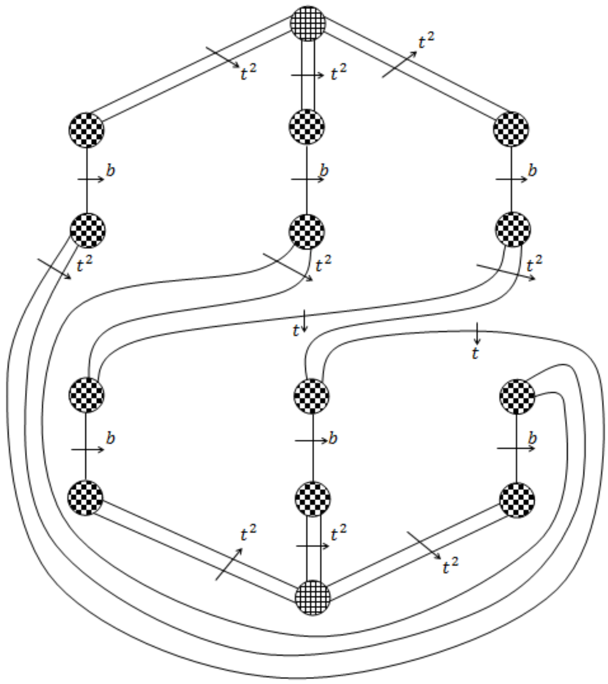
$P_1{}''$:



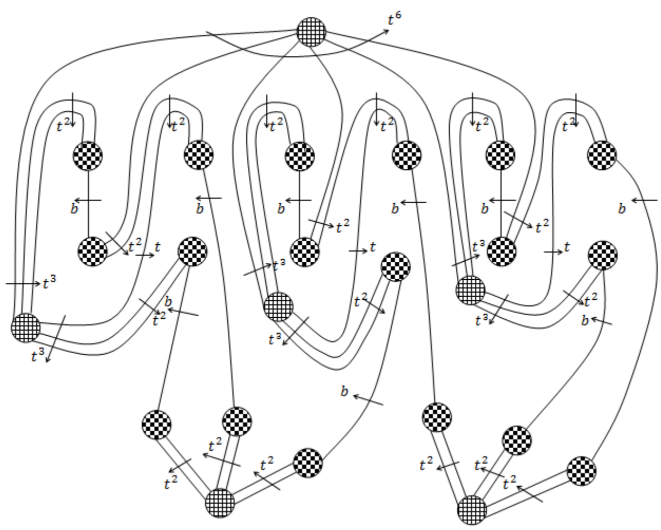
$P_3{}^{*}$:


t^3
t^3
t^2
t^2
b
b
t^2
b
t^2
t^3
t^3

$P_4{}^*$:


t^2
t^2
t^2
b
b
b
t^2
t^2
t^2
t
t
b
b
b
t^2
t^2
t^2

$P_5{}^\wedge$:


t^6
t^2
b
t^3
t^3
t
t^2

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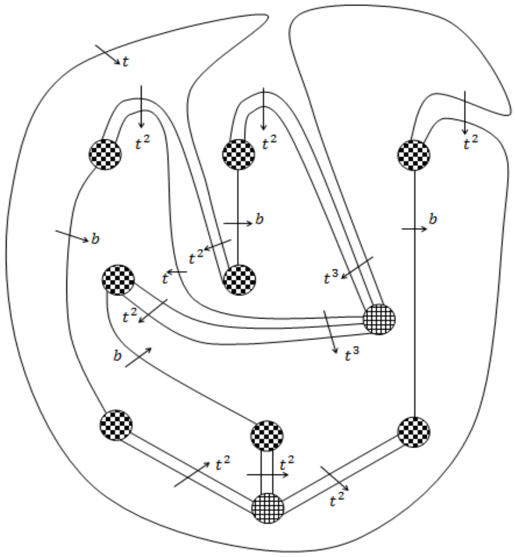
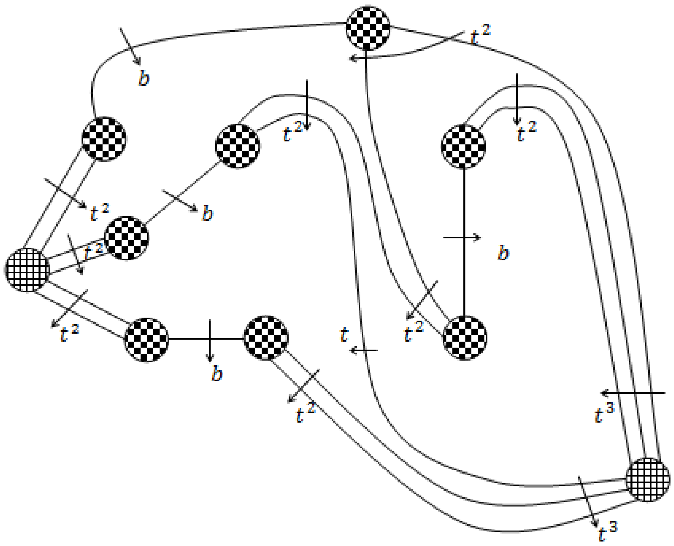
$P_6{}^{\wedge}$:



$P_7{}^{\wedge}$:

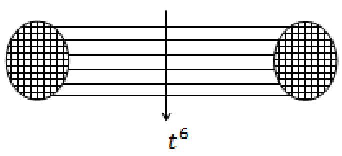


Generators of $\pi_2(\langle b, t; t^6, b = t^2\rangle)$ are $P_1{}''$, $P_2{}'$, $P_3{}^*$, $P_4{}^*$, $P_5{}^{\wedge}$, $P_6{}^{\wedge}$ and $P_7{}^{\wedge}$.

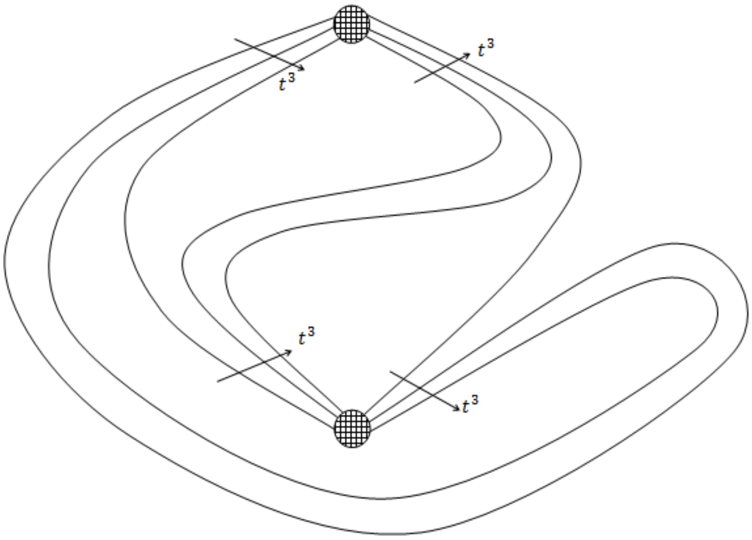
10. $\xrightarrow{T4} \langle t; t^6\rangle$

Generators $P_2{}'$, $P_3{}^*$, $P_4{}^*$, $P_5{}^{\wedge}$, $P_6{}^{\wedge}$ dan $P_7{}^{\wedge}$ will be changed and each one is named $P_2{}''$, $P_3{}^{**}$, $P_4{}^{**}$, $P_5{}^{\wedge\wedge}$, $P_6{}^{\wedge\wedge}$ and $P_7{}^{\wedge\wedge}$.

$P_2{}''$:

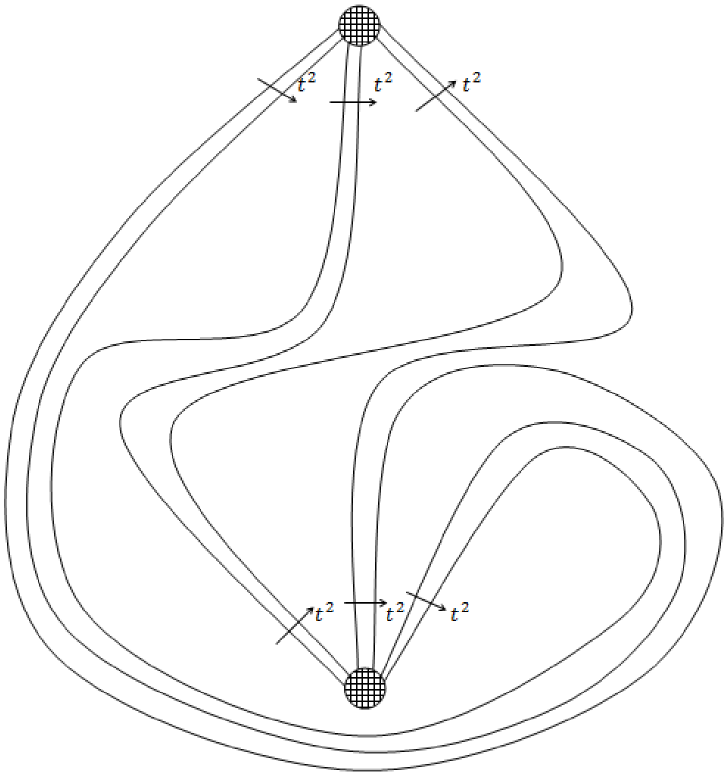


$P_3{}^{**}$:



$P_3^{**} = P_2''$.

P_4^{**} :



$P_4^{**} = P_2''$.

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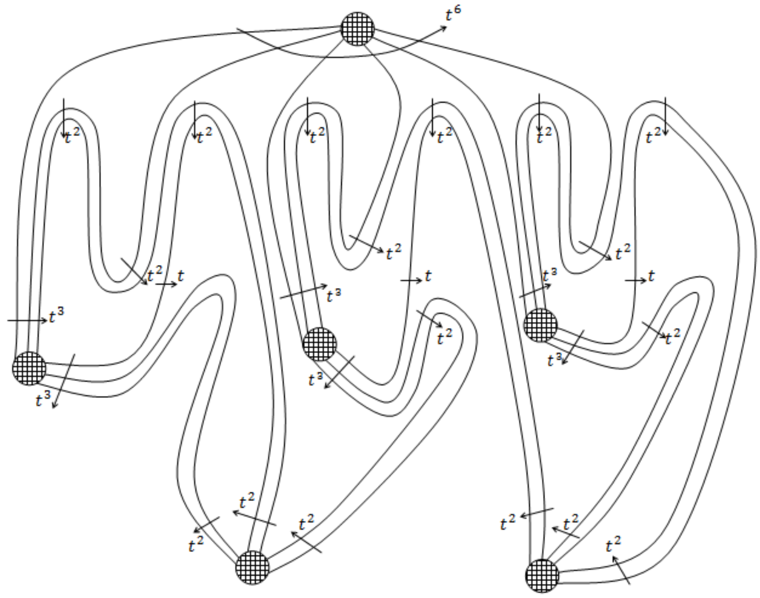
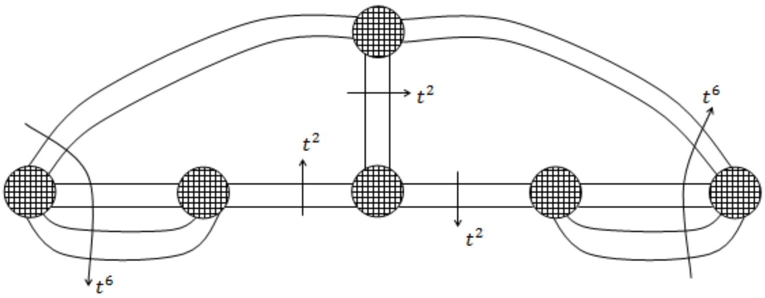
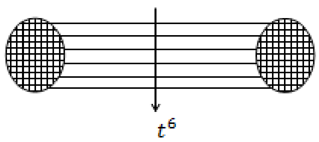
P_5^^ :



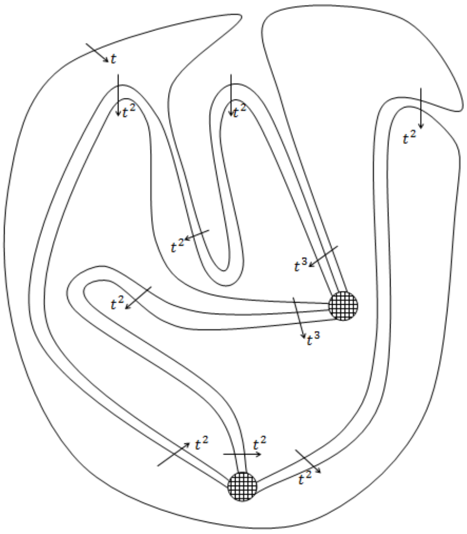
If generator P_5^^ simplified, then we obtain picture:



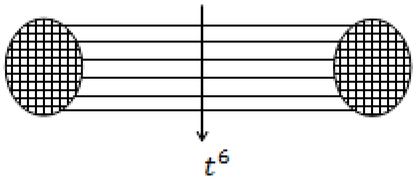
By using bridge move operation, we have:



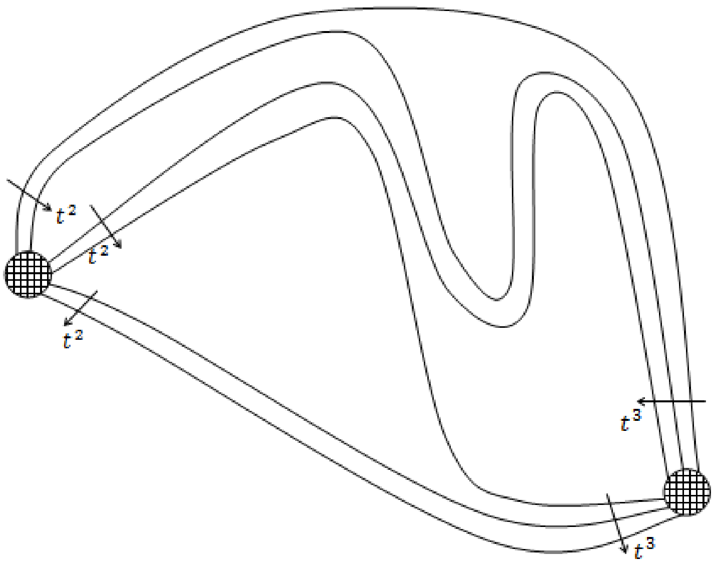
P_6^^:



This picture same as picture



P_7^^:



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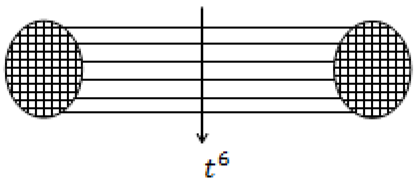

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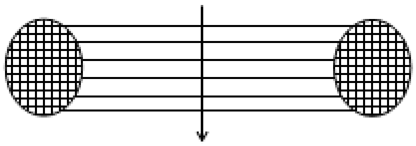
Thus, we have generator of $\pi_2(\langle t; t^6\rangle)$ is



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ME – 01

Literatur Study:
The Relationship of Mathematics Problem Solving and Students' Higher Order Thinking Skills

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***Abstract*—** The literature review is focusing on the use of mathematics problem solving in assessing students' higher order thinking. There is evidence that mathematics problem solving is related to critical, reflective, Metacognitive and creative as parts of higher order thinking. Theorizing from these findings, the study describes the relationship of mathematics problem solving and higher order thinking, how mathematics problem solving assesses students' higher order thinking and how mathematics problem solving might develop students higher order thinking. Findings suggest that more research is needed to gain new insight in categorizing mathematics problems that can be used in assessing and developing students' higher order thinking.
Keywords: *higher order thinkin skills, mathematics problem solving*

I. INTRODUCTION

This paper review about the use of mathematics problem solving in assessing and developing higher order thinking. The objective that gaided and motivated this review is our advocacy the use of problem solving in developing students' higher order thinking (HOT) since it is a necessary skills in the future [1]. Moreover, the opportunity to develop students' HOT skills has been shown by researches ([2], [3], [4]). Realizing the important of HOT skills, Indonesia government has conducted several efforts. The efforts are changing curriculum, teacher training and supporting research in education. Developing a learning instructions that can develop student competencies, HOT skills, becomes necessary. Pre-research that needed to be conducted is literature study. Doing a thorough analysis of literature study will provide information about theory and practices that related to development of HOT skills. This analysis can change researcher paradigm, point of view and theoretical perspectives about research area. As a result, the plan research can be guided to a new findings in HOT skills. Therefore, this literature review is conducted in order to find the relationship between HOT skills and mathematics problem solving.

The aim of this study is to review literature that related to HOT skills and mathematics problem solving in order to evaluate what is currently knowledge about how mathematics problem solving assess and develop HOT skills. The evidences are looked specifically in types of problems and reasons why problem solving is used in assessing and developing HOT skills.

II. HIGHER ORDER THINKING SKILLS

Higher order thinking has been defined by many researchers. Byrnes[5] defined higher-order thinking as a way of handling a situation that have not encountered before and is generally recognized as some combination of non-algorithmic, complex, effortful, nuanced judgments, application of multiple criteria, uncertainty about what is known and regulation. The characteristics that encounter of individuals are may vary in many ways, numbers and difficulties.

Regarding Bloom taxonomy, thinking processes that remarked as higher order thinking are synthesize, evaluate, and create. Based on this theory, many researchers defined HOT in a wide variety of definitions. The definition is summarizing as bellows:

1. King, Goodson, and Rohani [6] viewed than HOT skills are critical, logical, reflective, metacognitive and creative thinking. All of this aspects are activated when an individual encounter un familiar problems, uncertainties, questions and dilemma.
2. National Council of Teachers of Mathematics (NCTM) [7] proposed that HOT skills are required in solving non routine problem.
3. Anderson and Krathwohl [8] proposed the same definition as in bloom's Taxonomi which are a process that involve analyze, evaluate, and create.

4. Lopez and Wittington [9] believed that HOT skills Appeared when an individual receives new information and the information mixed such that it caused a new arrangement and extent the individual knowledge.
5. Weiss [10] suggested that HOT will appear when an individual faces a Collaborative, authentic, ill-structured, and challenging problems
6. Miri [11] showed that HOT skills are the strategy-where critical, systematic, and creative thinking are activated as a tactics. These activities are needed in order to get the objectives.
7. Rajendran [12] viewed HOT skills as the way to expand the use of mind in facing new challenges
8. Thomas and Thorne [13] defined that HOT skills require to think to higher levels. It requires that individual should deal with the facts, understand them, connect them each other until achieving new or novel knowledge.
9. Kruger [4] believed that HOT skills required the involvement of concept formation, critical thinking, creativity, problem solving, mental representation, rule use, reasoning and logical thinking.

Based on the definition of HOT skills that have been discussed, the further discussion will focus on several properties of HOT skills which are critical, reflective, metacognitive, and creative thinking.

A. Critical Thinking

Wood [15] Defined critical thinking as process of using reasoning in judging the facts and differentiate what is true and what is false. Critical thinking enables individual to assess and calculate situations and create reasonable conclusion. Lipmann [16] viewed critical thinking as skillful, responsible thinking that facilitates good judgment because it relies upon criteria, is self-correcting, and is sensitive to context. It is believed that in order to accomplish a good judgment of situations or facts an individual utilized reasonable thinking and responsible thinking. Another viewed about Critical Thinking Skills are skills that enable one to analyze and synthesize information to solve problems in broad range of areas [17]. It can be concluded that critical thinking is an ability to calculate and assess facts, situations and problems to formulate a good judgment/solution by using reasonable and responsible thinking.

Critical thinking occurs when students construct meaning by interpreting, analyzing, and manipulating information in response to a problem or question that requires more than a direct, one-right-answer application of previously learned knowledge [18]. This can be characterized by specific core thinking skills, which can be developed in the classroom through instruction and guided practice. The list of applicable skills includes, but is not limited to: focusing, information gathering, referencing, organizing, analyzing, integrating, and evaluation. Butterworth and Thaites [19] the core activities of critical thinking are analysis (identifying the key parts of the problem dan reconstructing it in a way that fully and fairly captures its meaning), evaluation (judging how successful a solution is) and further argument (self-explanatory) how the student’s opportunity to give their own response.

B. Reflective thinking

Reflective thinking – as an active, persistent, and careful consideration of any belief or supposed form of knowledge [20]. Taggard and Wilson [21] viewed reflective thinking as process of making informed and logical decisions. Meanwhile, Campbell-Jones & Campbell-Jones [22] recalling one’s own experiences, beliefs, and perceptions. The basic stages of reflective thinking

1. Determination of the problem
2. Reflecting the solution to the problem
3. Design of planning for problem solving process
4. Implementation of the designed plan
5. Performing evaluation by using reflection
6. And continuing by restarting the process in [23]

This give us the big picture that problem solving activity activates students or individuals reflective thinking. In solving a problem, individual is required to understand the problem, planning a way to solve it by utilizing the known and unknown information which is need a reflective thought, implementing the idea, and evaluate the result. In evaluating the result stage, an individual uses reflective thinking to looking back to the information, looking back to blue print of the plan, looking back in implementing the plan and the result. Reflective thinking activity will be well developed when the problem that is used is a complex problems. It will trigger an trial and error activities.

C. Metacognitive thinking

Research in metacognition has been done by many researchers. There are several definitions of Metacognition. Metacognition is the mind's ability to understand, reflect, monitor and control itself or, in other words, metacognition is the ability to know about what we know. [55], defined metacognition as individual's ability to know what he/she knows such as strengths and weaknesses, and using it to next level of knowing. Therefore, metacognitive thinking can be viewed as a person ability to understand their thinking, reflect on the knowledge that they have and using it to develop new knowledge.

D. Creative Thinking

Discussing about creative thinking cannot be separated from creativity. James C Kaufman, Plucker, and Baer [25] provide the definition of creativity as interaction among aptitude, process, and environmental. They believe that an individual or a group is called to be creative if they can produce a perceptible product. The product should be both novel and useful as defined within a social context. Moreover, they categorize the definition of creativity into three categories namely creativity as a person, creativity as a process, and creativity as product. Creativity as person, an individual characteristic is viewed as creator. According to Sternberg [26] , there are three psychological attributes of a person that interrelated with creativity. The attributes are intelligence, cognitive styles, and personality. The intelligence includes verbal knowledge, thinking flow, planning, formulation of the problem, preparation of the strategy, mental representation, decision-making, and globally intellectual integration. The cognitive styles include an individual act in doing things with his/her ways. Finally, the personality is related to personal factors such as flexibility, tolerance for ambiguity, self-discipline, and willingness to take appropriate risks.

Creativity as process is defined as steps in scientific method which are sensing the difficulties or problems, formulating the hypotheses, evaluating and testing the hypotheses, possibly revising and pretesting, and communicating the results [26]. It means that creativity is defined as an actual experience of being creative in encountering reality problems. An optimal experience occurs when an individual is intensely engaged in an activity.

Creativity as product is related to things people make, ideas, and responses. According to Baron (in Munandar [26]), creativity is an individual ability to produce/create new product. The product must be unique and novel to the creator. In this research, the definition of creativity is focused on creativity as product, especially creativity in mathematics problem solving.

In mathematics field, creativity is defined as an ability to combine logical and divergent thinking which is based on intuition but has a conscious aims [27]. The combination of logical and divergent thinking can be varied in different activities. In problem solving, divergent thinking will produce various ideas that might be possible to solve problems and logical thinking will provide considerations in choosing appropriate idea and in making decision. James C Kaufman et al. [25] summarized that there are four aspects of divergent thinking. First, fluency refers to numbers of responses to given stimuli. Second, Originality refers to uniqueness of responses to given stimuli. Third, flexibility refers to number and/or uniqueness of categories of responses to given stimuli. Fourth, elaboration refers to extension of ideas within a specific category of responses to given stimuli.

III. MATHEMATICS PROBLEM SOLVING

Problem solving is a human activity. Individuals encounter problem in their daily life. Therefore, problem solving become common activity by people. The definition of problem solving should be look carefully before the use of problem solving in assessing and developing HOT skills are discussed.

Many scientists have defined problem solving in many perspectives. [28] defined problem solving as a way to find a solution of a problem, so that a clear answer is established. A problem solver is encouraged to find a way or a structure such that the way or the structure can be used to find goals or solutions of the problem. [29] viewed "problem solving as an individual capacity to use cognitive processes to confront and to resolve cross-disciplinary situations where the solution path is not immediately obvious and where the literacy domains or curricular areas that might be applicable are not within a single domain of mathematics, science or reading". Meanwhile [7] considers problem solving as a process of applying previously acquired knowledge to new and unfamiliar (or unforeseen) situations. Despite of the definition that have been proposed, [30] viewed in the way when a problem solving is needed. It is needed when an individual encounter a question or a problem to be solved cannot be done through routine application/procedure of previously acquired knowledge. But it can be solved only when expanded use of mind occurred that a person must interpret, analyze or manipulate information. Based on the definitions, problem solving can be defined as an individual capacity to use cognitive processes to solve question or problem that cannot be solved by routine procedure of previously acquired knowledge.

IV. HIGHER ORDER THINKING SKILLS AND MATHEMATICS PROBLEM SOLVING

Higher order thinking (HOT) skills have strong connection with problem solving activity. It is because HOT Skills are activated when individual encounter unfamiliar problems, uncertainties, questions, or dilemmas [5]. In other words, all of the situations that can develop HOT skills are the characteristics of problem solving activity. Research found that both non-routine and open-ended problems give students more opportunities to demonstrate their problem solving skill. This activity can enhance students' Hot skills. However, if the same types of non-routine problems are given to student repeatedly, the essence to foster HOT skills will be lost (Gerald [31]).

Research that conducting by King, Goodson and Rohani [5] utilized problem solving activities both as a learning strategic to develop HOT skills and as assessment instruments. They believed that questions about dilemma, novel problems, and novel approaches that elicit answers are not learned by the students yet can be effective way to build many skills such as verbal analogies logical thinking, and inductive/deductive reasoning. In assessment of HOT skills, there are three tasks that can be used. The tasks are selection, generation, and explanation. Selection includes multiple-choices, matching, and rank order items. Generations includes short answer, essay, and performance item or tasks. Explanation involves giving reasons for selection or generation purposes.

Moreover, there are many resources (books and journal) discussed about HOT skills with problem solving activities that conducted separately to each skill such as critical thinking ([19], [32], [33]), Reflective thinking ([23], [34]), metacognitive ([35], Mayer [36], [37], [38], [39], [40]) and critical thinking ([41], [42], [43]). The problem that is used in these researches are real life problem, open problem, open-ended problem, non-routine problem, and complex problem. These kinds of problems require problem solvers to think harder in unusual ways since there is no exact formula that can be used directly. Placing problem solvers in a unclear and miserable condition that challenge their way of thinking, various ideas and unknown variable will trigger the activating of HOT skills.

Looking to the opportunity that problem solving activities created to develop students HOT skills, further research in designing problem based instruction in class in developing HOT skills become necessary. This is a vast research area since there only few of researches about that is conducted by utilizing problem solving in developing HOT skills. Moreover, every component of HOT skills also needs a further research.

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ME – 02

A Study Of Reflective-Preservice Mathematics Teacher's Reflective Thinking In Solving Geometrical Problem

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Abstract**—**Reflective thinking is one of the basic competencies which must be had by students in learning mathematics, especially in solving mathematical problem. The purpose of this study is to describe how reflective thinking is used in solving geometric problem. The subject of this study is a student who has reflective cognitive style enrolled in Mathematics Education, Faculty of Teacher Training and Education (FKIP), Universitas Muhammadiyah Makassar, Indonesia. This study is a descriptive explorative study with data analysis using qualitative approach. Qualitative approach is chosen to describe in depth related to reflective thinking of prospective teacher in solving geometrical problem that can be seen from the subject's behavior in completing a given task and semi-structured interviews are administrated to the subject. During the interview, participant is asked by researcher to describe subject's reflective thinking. There are four main categories to analyze the data related to prospective teacher's reflective thinking in solving geometrical problem: (1) formulation and synthesis synthesis of experience, (2) orderliness of experience, (3) evaluating the experience and (4) testing the selected solution based on the experience

Keywords: *cognitive style, geometrical problem, reflective thinking*

I. INTRODUCTION

Every student must have essential competencies in learning mathematics. One of the essential competencies is students' ability in solving a problem which is suffered or faced. This competence must be recomended to be drilled and appeared since children learn mathematics from elementary school [1], [2]. As a consequence, the handling of mathematical learning process should be done well [3].

In solving a problem, everyone must always involve thinking process, in similiar things that were expressed by Solso [4] that thinking activity is directed to produce problem-solving. Additionally, Siswono [5] stated that thinking is a mental activity which is experienced by someone or a person when they were faced with a problem or situation to be solved or resolved. So it can be concluded that the purpose of thinking is to solve a problem or get answers during students complete math problems, students undertake a process of thinking, so that students can find the answers even if the answer is not necessarily true.

One types of thinking that can be applied in teaching mathematics is reflective thinking [6]. This is due to the learning objectives of mathematics such as comprehension, problem solving, connections of mathematical, mathematical communication and other abilities will be owned by the students well when students are aware of what is right, summed up what it is supposed to do when experiencing failure, and evaluate what has been done.

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Some institutions and professional development of teachers have been doing the alternate learning to improve reflective thinking skills that are beneficial to student teachers. Such benefits can be felt during becoming student and after the student completes his education in LPTK (Institutions of Teachers and Education Personnel) [7]. Currently reflective thinking is very interesting to study. This is according to Lim's [8] and Amidu's [9] research which stated that the reflective thinking had become the most prominent issues in the literature, in particular on professional education of teachers.

Reflective thinking done by teacher aims to achieve learning targets and generate new learning approaches that have a direct impact on the learning process. Furthermore, it is explained that the process of reflective thinking can be used by teachers, student teachers and students in the learning process and learning are included in mathematical problem solving [10]. Therefore, it is suggested that teachers need to engage in reflective thinking and not only learn new ideas related to the concept of learning but also involved in the process of solving problems associated with the mastery of concepts or content of the material that is taught so as to improve the quality of professionalism [11].

A teacher who engages in reflective thinking will be critical to the process of resolving the problem which he did. This is in accordance with Kember's opinion [12] which stated that the reflective thinking involves assumptions that are critical to the content or process of solving the problem. In addition, teachers who can reflective thinking can master the concept well. Where the opinion is supported by Barrow stating that reflective thinking in solving problem help someone form concepts and abstractions and develop new concepts that eventually produce a solution of the given problem [13].

Therefore, the professional teacher is a teacher who is able to think reflectively and master the concepts so well that it can explain the material well. A similar sentiment was expressed by Yeo [14] and Thames [15] that a teacher cannot be expected to explain the mathematical concept if it does not have a complete understanding of the mathematical concepts being taught. In other words, teachers' mastery of learning materials (subject matter) becomes very important for success in teaching.

According to Lee [16], there are five phases of reflective thinking, namely:

a) Problem context (identifying the problem)
b) Problem definition (restrict or define the problem)
c) Seeking possible solution (look for possible solutions)
d) Experimentation (using one possible solution of the problem or solution is best done)
e) Evaluation (evaluate / test)
f) Acceptance / rejection (accept or reject)

In addition, Rodgers [11] explained that there are four stages in reflective thinking process, namely:

a) Presence to experience (try to present the experience)
b) Description of experience (describing the experience)
c) Analysis of experience (analyzing the experience)
d) Intelligent action/experimentation (try to practice one of the best solutions in solving problems)

Dewey [17] suggests that there are six phases in reflective thinking:

a) An experience (try to remember things related to the experience before)
b) Spontaneous interpretation of the experience (interpreting spontaneity toward the experience)
c) Naming the problem or question that arise out of the experience (mention any problems or questions that arise from experience)
d) Generating possible explanations for the problem or question posed (building or constructing possible explanations of problems or questions that are given)
e) Ramifying the explanation into full-blown hypotheses (provide explanations in the form of a clear hypothesis)
f) Experimenting or testing the selected hypotheses (practicing or testing the hypothesis chosen)

Based on several previous opinions, the component of reflective thinking process can be illustrated in Table 1 below:

TABLE 1. CONSTRUCTION OF REFLECTIVE THINKING PROCESS

Dewey (1933) (PBRD)	**Lee (2000) (PBRL)**	**Rodgers (2002) (PBRR)**	**Zehavi & Mann (2006) (PBRZM)**	**Reflective Thinking Process**
An experience	*Problem context*	*Presence to experience*	*Selection of techniques*	*Formulation and synthesis of experience*
Spontaneous interpretation of the experience	*Problem definition/ Reframing*	*Description of experience*	*Monitoring of the solution process*	
Naming the problem				
Generating possible explanations for the problem	*Seeking possible solution*	*Analysis of experience*	*Conceptualization*	*Orderliness of experience*
Ramifying the explanations into full-blown Hypotheses			*Insight or ingenuity*	*Evaluating the experience*
Experimenting or testing the selected hypotheses	*Experimentation*	*Intelligent action/ Experimentation*		*Testing selected solution based on the experience*

According to the table, obtained construction reflective thinking process with four stages. These stages are: (1) Formulation and synthesis of the experience; (2) Orderliness of experience; (3) Evaluation of experience; and (4) Testing the selected solution based on the experience. To find out what happens when these stages, the student or the subject will be interviewed in-depth on matters concerning the four stages and linkages that may affect it.

By reflective thinking, students can solve more complex problems because the tought of students will be directed and students think reflectively toward solution or settlement of the problem being solved tend to be true and correct. This is according to research King and Kitchener [18] which states that the reflective thinking help somebody in solving complex problems, due to reflective thinking helps a person identify concepts, facts, formulas, and theories that are relevant to the solution of problems identified. In addition, reflective thinking also involves the process of analyzing, comparing, synthesize, clarifying, and choosing what someone is doing that shows the reflection itself [19], [20].

When someone does the activity of analyzing, comparing, synthesize, clarifying, and choosing, then he or she will do it in different ways based on their character. Everyone has a character different or unique [21], so as to learn, master, process information, solve problems, and to teach the material well, in this case the mathematics, someone will do it in a way that is different also [22].

Every students has a cognitive style. Differences in cognitive styles have affected the ability of students in reflective thinking and solving problems. This is in accordance with the opinion of Coop and Sigel that the cognitive styles correlate with intellectual and perceptual behavior. Intellectual associated with a person's ability to think, while perceptually associated with a person's ability to view or interpret anything.

A number of cognitive styles have been identified in the literature, for example, Abdurrahman [23] states that one of the dimensions of cognitive style that is enough to attract attention in assessing children who have difficulty in learning is a cognitive style impulsive-reflective (to answer the problem quickly, but a lot of mistakes and addressing slow but less error prone).

Jerome Kagan introduced impulsive and reflective cognitive styles in 1965. Kagan classified the cognitive styles based on the amount of time which is used by a person in responding to a situation and the accuracy of the answers of the response given. People who have the characteristic uses short time in addressing the problem, but no/less careful so that the answers tend to be wrong, called the person who had an impulsive cognitive style. Meanwhile, people who have the characteristic uses long time in answering the question, but carefully/meticulously so that the answers given tends to be true, called people who have cognitive style reflective.

With the cognitive styles are different, there is the possibility of students solve problems in different ways, according to the reflective thinking skills and his perceptions of a given problem. To find out if it really happens, it needs to be explored further.

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II. METHOD

This type of research is a descriptive study with qualitative approach which aims to describe in depth about the student's reflective thinking process in solving geometrical problem based on cognitive style. To get description of student's reflective thinking process who has reflective cognitive style in solving geometrical problem, subject was given a task of solving geometrical problems which are presented. Furthermore, subject was interviewed to dig deeper into how students think and acquire new information that may be obtained from the task which is performed by subjects. Data from duties and the interviews were analyzed and further described in the form of written words or a description of the subjects.

The research was conducted in Department of Mathematics Education, Faculty of Teacher Training and Education (FKIP), Makassar Muhammadiyah University. Subjects in this study were student teachers in academic year 2013/2014 (fifth semester). Determination of research class is based on the consideration that students in semester VI have enough time, so that making it easier to do the interview.

The purpose of this study was to analyze the ability of preservice teachers' reflective thinking process in solving geometrical problem who has reflective cognitive styles. To achieve this goal, several stages will be carried out as follows: (a) the first stage, the determination of research subject who has cognitive style of reflective by using specific criteria ; (b) the second phase, preparing problem solving tasks which can describe or appeare reflective thinking process of subject that has been validated by several experts; (c) The third stage, interview which is not structured, informal to verify the data from tasks of problem solving; (d) The fourth stage, recording with the recorder and use the records. This meant that no information is missed or lost during the interview; (e) the fifth stage, analyzing of research data related to the process reflective thinking in solving geometrical problems by subjects (preservice teachers).

This research is exploratory descriptive study with data analysis by qualitative approach which main data in the form of words that are linked into sentences. Qualitative method is chosen for profile students' understanding of the natural background and the main instrument is the researcher's own research. It means that the data which is analyzed in form descriptive and not in the form of figures as well as in quantitative research.

To obtain valid data in this study, then do the validation data. One of the qualitative research validation procedures that can be performed is by means of triangulation. Validation of the data in this way is done by repeatedly checking with different time. Sugiyono [24] called the data validation process by triangulation of time.

III. RESULT

Based on the result of construction reflective thinking process which is divided into four stages. These stages are: (1) Formulation and synthesis of the experience; (2) Orderliness of experience; (3) Evaluation of experience; and (4) Testing the selected solution based on the experience. To find out what happens on every stage related to reflective thinking in solving geometrical problem, the participant or the research subject will be interviewed in-depth on matters concerning the four stages and linkages that may affect it.

The results of task-based interview of the subject on data collection that illustrates the process of reflective thinking in solving geometrical problems by preservice teacher who has reflective cognitive style as follow.

The first stage, **formulation and synthesis of the experience**, the participant described problem by using his own word, the participant explained problem clearly related to the main point from the problem. The participant also can find the concepts which are related to the problem given. For more clearly, the following is a transcript of the interview excerpt based on this stage.

P Baik. Kira-kira, jika dengan menggunakan bahasa ade sendiri, apa yang adik pahami tentang soal ini secara keseluruhan?

S Terkait pemahaman saya terhadap soal ini yang saya pahami adalah, yaitu soal ini menuntut kita untuk mencari sebuah luas.

P Luas apa?

S Luas dari taman bunga, yang berbetuk persegi atau persegipanjang tapi belum diketahui panjang sisi-sisinya, entah itu apakah panjangnya atau lebarnya, tergantung nanti proses penyelesaian soal saya seperti apa.

P Terus?

S Pada soal ini juga, memuat beberapa konsep persegi atau persegipanjang, konsep luas, perkalian, konsep perbandingan, kensep sudut, dan konsep kesejajaran.

From the transcript above, it can be explained that the participant described the problem by using another word however participant's explanation still has the same idea from the problem. Furthermore, when the subject identified concept or subject matter which is related to the problem, the participant mentioned not only the concept that ever the participant used in solving a problem before, but also the participant explained that the concept which will be used in solving the geometrical problem. For more clearly, the following is a transcript of the interview excerpt based on this stage.

P Sebelumnya, apakah adik pernah melihat soal seperti ini?
S Nda persis sih soalnya seperti ini, tapi dalam kehidupan sehari-hari atau di sekolah, biasanya, inikan berbentuk soal cerita. Kalau soal cerita seperti ini, biasanya itu, memuat konsep aljabar.
P Memuat konsep aljabar, maksudnya?
S Dalam kehidupan sehari-hari, biasanya kalau soal cerita pada kehidupan sehari-hari itu, bisanya memuat pemisalan seperti seseorang membeli buku, bukunya itu diganti dengan x berapa buah. Kalau misalnya kita membeli 3 buku, kita bisa menuliskan 3x.
P Ok kalo begitu, dulu ketika menghadapi soal yang seperti ini konsepnya terkait apa saja?
S Kalau soal yang dulu, biasanya langsung terkait konsep aljabar,konsep sudut, konsep segitiga, persegi, persegipanjang.
P Masih ada lagi konsep yang lain terkait soal yang pernah ade hadapi?
S Hmm, oh konsep lingkaran pak. Yah mencari luas lingkaran, keliling lingkaran. Ya itu pak.
P Coba, perhatikan soal tersebut dengan seksama yang ada dihadapan ade itu. Soal tersebut terkait dengan konsep apa saja?
S Hmm, pertama pasti terkait dengan konsep persegipanjang. Karena dalam soal sudah disebutkan bahwa taman bermainnya berbentuk persegipanjang. Yang kedua, juga ada konsep sudut. Ketiga konsep perbandingan, ke empat konsep kesejajaran, konsep luas, juga konsep perkalian.
P Kok konsep perkalian?
S Kalau konsep perkalian kan akan dibutuhkan pada saat menghitung luas dari taman bunga.

The second stage, **orderliness of experience**, the participant described strategy in solving the geometrical problem given. The participant explained the steps in choosing operation well related to the problem. For more clearly, the following is a transcript of the interview excerpt based on this stage.

P Baik, dengan informasi yang anda peroleh kira-kira strategi apa yang anda gunakan untuk meyelesaikan soal ini?
S Dari informasi yang diperoleh atau yang diberikan dari soal ini, pertama-tama yang saya kerjakan terlebih dahulu adalah menggambar pak.
P Apa yang kamu mau gambar?
S Ehhh, taman bunganya pak. Ehh taman bermainnya pak. Saya menggambar bentuk taman bermainnya serta menggambar taman bunga yang ingin dicari luasnya pak.
P Ok. Sekarang, saya tanya lagi. Kamu kok menggambar? Padahal kan soalnya tidak menuntut kamu menggambar?
S Ehh, bagi saya pada soal ini, memang tidak meminta saya menggambar. Tetapi, untuk memperoleh informasi yang lebih jelas, dan akurat. Saya kira kita harus menggambar terlebih dahulu, supaya kita bisa memahami dengan jelas, maksud dan tujuan dari soal ini.
P Ok. Terus setelah menggambar apalagi?
S Setelah menggambar saya, mencatat apa-apa yang diketahui dari soal pak. Contohnya, sudut yang diketahui dari soal yaitu sudut 45 derajat dan gambaran saya itu, saya mengumpakan bahwa sudut SPD itu 45 derajat.
P Sudut SPD?
S Iya Pak, sudut SPD seperti pada gambar ini pak (sambil menunjukkan hasil dari gambar subjek berdasarkan hasil gambaran yang diperoleh dari soal). Ini sudut A, sudut B, C dan D yang diberikan dari masing-masing dari sudut taman bermain itu adalah 90 derajat. Sudut SPQ itu juga 90 derajat dari sudut masing-masing taman bunga.
P Ok. Terus apalagi?
S Saya, menuliskan juga apa yang ditanyakan. Pada soal ini kan yang ditanya itu luas taman bunga. Pada penyelesaian ini, saya umpakan taman bunga sebagai persegipanjang PQRS.

The participant also can explain the difficulties when the participant tried to apply the strategy to solve the problem given. The following is a transcript of the interview excerpt based on this stage.

P Ok, sekarang, jadi kesulitan yang anda hadapi untuk menerapkan strategi ketika menyelesaikan soal ini adalah?
S Itu tadi pak, eehh, yaitu mengaitkan antara konsep satu dengan konsep lainnya, agar tidak terjadi kesalahan dalam pengerjaan. Misalnya yang tadi ini, konsep sudut dengan konsep segitiga. Konsep perbandingan pada ruas garis, kemudian mengaitkan konsep sudut
P Maksudnya?
S Inikan nantinya, maksudnya prinsip-prinsip sudut, contohnya sudut berpelurus. Jumlah sudut berpelurus itukan sama dengan 180 derajat, maka dengan jumlah keseluruhan sudut yang terdapat pada pada garis lurus itu 180 derajat pak.

From the explanation above, it can be concluded that at this stage, the participant gave an explanation how choose a operation or strategy accurately and the participant can find difficulties and explain it related to the strategy chosen.

The third stage, **evaluation of experience**, the participant can find also strengths and weaknesses of solutions that had been done and explain how the effort to improve the weaknesses that are owned or carried when solving problems. For more clearly, the following is a transcript of the interview excerpt based on this stage.

.

P Coba kamu sebutkan kelebihan dan kekurangan terkait penyelesaian yang kamu lakukan
S Kelebihannya itu pak, bisa memindahkan informasi dari bentuk soal ke dalam bentuk gambar, bisa memberikan informasi yang lebih jelas lagi. Saya mudah mengeceknya kembali apabila mau dikroscek kembali dari awal karena penyelesaiannya saya itu secara runtut. Kekurangannya mungkin butuh waktu yang agak lama karena harus lebih teliti. Contohnya saja tadi, karena saya kurang teliti terdapat sebuah kesalahn dalam penulisan operasi, contohnya tadi itu, tadi saya tulis tambah, tapi setelah saya cek kembali, saya tahu kesalahan saya berada saya di situ.
P Tadi itu kan kamu menyebutkan kelebihan dan kekurangan terkait penyelesaian yang kamu lakukan. Sekarang, kira-kira, upaya apa yang anda lakukan untuk mengurangi kelemahan ketika menyelesaiakan soal?
S Ehh, mungkin upaya yang saya lakukan yaitu, contohnya lebih konsentrasi dalam menyelesaian soal
P Kenapa?
S Saya sadar betul, bahwa dalam menyelesaikan soal apapun itu bentuknya, seseorang harus lebih tenang, konsentrasi, dan rileks. Kemudian kita bisa berpikir lebih jernih dalam menyelesaikan soal.

From the transcript of interview above, it can be concluded that the participant can give the explanation about strengths and weaknesses from the solutions which had been done, namely the participant can formulate or transform from verbal to picture or other forms. On the other hand, the participant can explain the effort to revise and improve the weakness that are owned or carried when solving geometrical problems, for example; when the participant resolve any matter that are in any forms, the subject of research must be calm, concentration, and relax. Then we can think more clearly in solving gemetrical problems.

The fourth stage, **testing the selected solution based on the experience**, the participant explained whether the answers or solutions which are obtained can answer the issues presented and explained how to test the internal consistency or error in operation or in the solution from the problem solving which had been done. For more clearly, the following is a transcript of the interview excerpt based on this stage.

P Menurut Anda, penyelesaian yang anda lakukan ini telah menjawab permasalahan dari soal ini
S Sudah pak
P Apa permasalahan dari masalah atau soal ini?
S Permasalahna dalam soal inikan menentukan luas taman bunga
P Apakah kira-kira sudah menjawab permasalahan ini?
S Sudah pak, kan permasalahan dalam soal ini adalah mencari luas taman bunga yang berbentuk persegipanjang jadi saya mencari panjang dan lebar dari taman bunga dan saya sudah menemukan panjang dan lebar dari taman bunga, kemudian saya operasikan lalu akhirnya saya mendapatkan luas dari taman bunga ini.
P Jadi yang anda lakukan untuk meyakinkan bahwa penyelesaian yang anda lakukan ini sudah menjawab pertanyaan dari permasalah soal ini adalah?
S Karena, untuk menentukan luas dari taman bunga ini, yang saya butuhkan adalah panjang dan lebar dari taman bunga ini kemudian panjang dan lebar dari taman bunga saya sudah temukan
P Tapi kamu yakin dengan panjang dan lebar yang kamu temukan itu?
S Yakin pak
P Mengapa anda yakin dengan ukuran panjang dan lebar yang anda temukan itu?
S Ehhh, karena dari proses penyelesaian ini, setelah melihat kembali, dan mengecek kembali ini sudah, semuanya sudah memenuhi prosedur tetapi jika perlu saya akan menyelesaikan soal ini dengan cara yang berbeda.
P Maksudnya dengan cara yang berbeda?
S Ahhh, kan bisa saja ini soal bisa diselesaikan dengan beberapa cara, untuk meyakinkan jawaban saya kembali. Saya bisa menggunakan cara yang lain untuk menyelsaikan soal ini dan apabila jawabannya sama, maka jawaban saya ini saya sangat yakin sudah benar
P Apanya yang anda bandingkan? Ketika anda menyelesaikan soal ini.
S Ehhh, jawaban terakhirnya pak. Luas taman bunga, apabila luas taman bunga yang saya peroleh sama dengan cara berbeda maka saya yakin ini sudah benar

From the transcript of interview above, it can be concluded that the participant can give the explanation about the answers or solutions which are obtained from the solutions which had been done had answered the geometrical problem given, namely the participant can find the point from the problems (length and width of flower garden) which can help in finding the area of flower garden. Although, in the problem, the length and width are not mentioned specifically, the participant can find them and they help the participant in solving geomterical problem or finding the solutions. Furthermore, to test the internal consistency or error in operation or in the solution, the participant checked and looked back related procedures and operations which is used. Moreover, the participant tried to resolve the problem in a different way to compare the answers which had been obtained before.

IV. CONCLUSION

From the results of this study, it can be concluded that the participant can solve the geomterical problem by using his reflective thinking in four stages. The four stages are:

1. The first stage, **formulation and synthesis of the experience**, the participant described problem by using his own word, the participant explained problem clearly related to the main point from the

problem. The participant also can find the concepts which are related to the problem given. Furthemore, the participant described the problem by using another word however participant's explanation still has the same idea from the problem. Moreover, when the subject identified concept or subject matter which is related to the problem, the participant mentioned not only the concept that ever the participant used in solving a problem before, but also the participant explained that the concept which will be used in solving the geometrical problem.

2. The second stage, **orderliness of experience**, the participant described strategy in solving the geometrical problem given. The participant explained the steps in choosing operation well related to the problem. Further, the participant gave an explanation how choose a operation or strategy accurately and the participant can find difficulties and explain it related to the strategy chosen.
3. The third stage, **evaluation of experience**, the participant can find also strengths and weaknesses of solutions that had been done and explain how the effort to improve the weaknesses that are owned or carried when solving problems. It means that the participant can give the explanation about strengths and weaknesses from the solutions which had been done, namely the participant can formulate or transform from verbal to picture or other forms. On the other hand, the participant can explain the effort to revise and improve the weakness that are owned or carried when solving geometrical problems, for example; when the participant resolve any matter that are in any forms, the subject of research must be calm, concentration, and relax. Then someone can think more clearly in solving gemetrical problems.
4. The fourth stage, **testing the selected solution based on the experience**, the participant can give the explanation whether the answers or solutions which are obtained can answer the issues presented. In addition, the participant can explain how to test the internal consistency or error in operation or in the solution from the problem solving which had been done. For example, the participant checked and looked back related procedures and operations which is used. Moreover, the participant tried to resolve the problem in a different way to compare the answers which had been obtained before.

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ME – 03

A Study of Late Formal-Junior School Student's Geometric Thought in Understanding the Relationship Between Quadrilateral

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***Abstract*—**Currently, geometric thought is one of the important things which become a concern in learning mathematics, especially in learning of geometry. Learning of geometry must be allowed to the students' geometric thought will enhance the intellectual engagement of students, because it can help the student in directing his thoughts so that the solution of the problem being solved tends to be true and correct. The purpose of this research paper is to describe how geometric thought is used in understanding the relationship between quadrilaterals. The participant of this research is a student who is at the early formal operational stage based on Piaget's development of cognitive enrolled in class VIII SMP, Kabupaten Bone, South Sulawesi, Indonesia. This research is a descriptive explorative study with data analysis using qualitative approach. Qualitative approach is chosen to describe in depth related to student's geometric thought in understanding the relationship between quadrilateral that can be seen from the subject's behavior in completing a given task and semi-structured interviews are administrated to the subject. During the interview, participant is questioned by researcher to investigate subject's geometric thought. To test the credibility of the data, the researcher used triangulation time. The results of this research showed that the student who is at the late formal operational stage based on Piaget's stages of cognitive development stringing up or composing 7 relationships from 15 relationships between quadrilaterals and the student or subject drew various kinds quadrilateral by using 4 attributes i.e. position, the size, shape of quadrilateral and rotational symmetry.

Keywords: *Geometric Thought, Late Formal Stage, Quadrilateral*

I. INTRODUCTION

Geometry is one subject that addresses school math objects associated with spaces of varying dimensions. The concept of geometry itself occupies a special position in the secondary mathematics curriculum because it is closely related to other forms of objects that are often encountered by students in everyday life. Various opinions appeared that discusses geometry both definitions and chances to be taught in SMP [1]. One of the shapes is taught in junior class VIII is a quadrilateral. Topics include the quadrilateral parallelogram, rhombus, rectangle, square, trapezoid, and kite. Muser [2] defines that the types of quadrilateral as follows: A square is a quadrilateral with four sides the same length and four right angles. A rectangle is a quadrilateral with four right angles. A parallelogram is a quadrilateral with two pairs of parallel sides. A kite is quadrilateral with two no overlapping pairs of adjacent sides that are the same length. A rhombus is a quadrilateral with four sides the same length. A trapezoid is a quadrilateral with exactly one pair of parallel sides.

One of the relationships between the various types of quadrilateral described by Soedjadi [3] based on the intention can be seen in Figure 1. below:

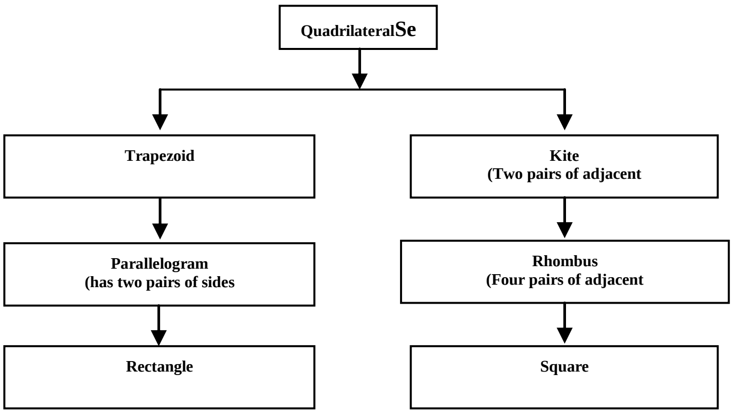

FIGURE 1. THE RELATIONSHIP BETWEEN VARIOUS TYPES OF QUADRILATERALS

Based on the picture above, trapezoid is is defined using the genus proksimum (closest family) "quadrilateral" by adding the terms "has a pair of parallel sides". Thus the trapezoid is is a quadrilateral which has a pair of parallel sides. In a similar manner, a trapezoid is parallelogram which has two pairs of parallel sides and a rectangle is a parallelogram that has a right-angle. Likewise for kite defined as a quadrilateral having two pairs of adjacent sides equal in length. Rhombus is a kite that four adjacent sides of equal length. Square is a rhombus is has a right-angle.

Related to the topic of the quadrilateral as one of the subjects in the field of geometry taught in junior high, Sunardi [4] found many students were wrong in solving the problem of parallel lines. Based on this, the geometry is looked as part of math given to students classified as difficult. Students' s learning difficulties can not be separated from the practice of learning that has been in progress [5]. Idris [6] suggested that learning of geometry is not easy and some students fail to develop an understanding of the concept of geometry, geometric reasoning and skill to solve the problems of geometry. Furthermore, Idris stated that a number of factors that lead learning of geometry is difficult which they are language of geometry, visualization and learning abilities are less effective for the low mastery of facts, concepts and principles of geometry.

According Soerjono [7] one of among the causative factor is the intellectual ability of students. The results of Burger and Shaughnessy's research [8] demonstrated that the intellectual ability of students plays an important role in the mastery of facts and concepts of geometry. Intellectual abilities are spatial ability and auditory ability which are very close relationship with the cognitive aspects of students in general. Research shows that the understanding of spatial knowledge can affect the performance related to academic tasks especially math, reading and science [9]. According to Piaget and Inhelder [9] states that spatial ability which is an aspect of cognition that develops in line with the cognitive development.

Piaget [10] describes the sequence into four stages of cognitive development which is qualitatively different, namely: (1) the stage of sensory motor (2) pre-operational stage, (3) the concrete operational stage, and (4) the formal operational stage. He claimed that all children pass through four stages with different speeds, but none of the children who passed through one of the four stages [10, 11]. Piaget suggested that students should use logical operations to get structure of knowledge and their changes [12]. The more often children move and find new things, the children will increasingly have new schemes that are used to develop their logical operation [11].

Formal operational by Sawyer et al, Dickinson and Lee in Philip Adey split into 2 of the formal operation of early formal operations and late formal operations [12]. Students at the early formal have a good effort to solve the problems by using all its logical operations. The resulting solution is correct but there are little mistakes in using a type of logical operation. They can predict the final answers so that any data and information geared towards achieving that goal. Students at the late formal is able to answer correctly. They show the use of logical operations well. They relate the data and information to resolve pemasalahan. If there is an impasse in resolving a problem they can find another alternative. Children demonstrate a broad understanding of the problem, using a cognitive schema to build understanding of the structure of the problem, as well as choosing the right strategy. By using the scores as a basis and pay attention to the level of understanding of the students showed in solving problems, level of cognitive development of students based on tests of logical operations Piaget classified as shown in Table 1 below.

TABLE 1. LEVEL OF STUDENTS'S COGNITIVE DEVELOPMENT BASED ON TEST OF LOGICAL OPERATION PIAGET

Interval Score	Level Of Students's Cognitive Development
0-35	Early Concret
36-70	Late Concret
71-105	Early Formal
106-140	Late Formal

(Adopt from Loengson dan Limjap, 2003: 13-14)

II. METHOD

This research is exploratory descriptive study with data analysis by qualitative approach which main data in the form of words that are linked into sentences. Qualitative methods is chosen for profile students' understanding of the natural background and the main instrument is the researcher's own research. It means that the data which is analyzed in form descriptive and not in the form of figures as well as in quantitative research.

This research was conducted in Watampone, Bone district, Makassar, South Sulawesi. The participant in this study is student of class VIII SMP. The reason for choosing a class VIII student junior high school student is at the stage of formal operations, so that students are able to think more abstractly, capable of inductive and deductive thinking and be able to think logically.

To determine the stage of cognitive development of students who are at the late formal stage, then used the test instrument Logical Operations Piaget (Piaget TOL) developed by Leongson, JA & Limjap, AA (2003). The instrument is a matter of form description which consists of 35 questions. With reference to the opinion of Schoenfeld and Avalanche & Limjap, researchers determined the students' level of cognitive development by Piaget logical operation test. If the scores obtained by students 106-140, the level of cognitive development of students at the level of late formal.

To obtain valid data in this study, then do the validation data. One of the qualitative research validation procedures that can be performed is by means of triangulation. Validation of the data in this way is done by repeatedly checking with different time. Sugiyono (2005) called the data validation process by triangulation of time.

III. RESULT

The results of task-based interview of the subject on data collection that illustrate understanding of the concept of quadrilateral of student through drawing, identifying and making diagram of relationships between quadrilaterals as follows.

Junior high school students with stage of cognitive development at the stage of **late formal operations** when drawing rectangles, students can draw variety of different rectangular shapes are infinite by paying attention to the attributes of the shape, the size and position of quadrilateral

More clearly on task-based interviews, **the activities of subject when drawing a quadrilateral**, the subject drew quadrilateral by paying attention to characteristics or attributes of quadrilateral drawn as in the following figure 2.

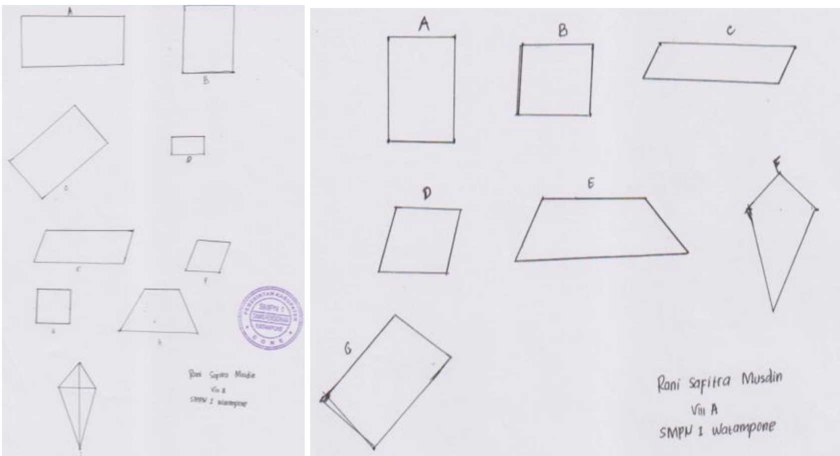

FIGURE 2. VARIOUS QUADRILATERAL DRAWN SUBJECT AT THE INTERVIEW

The following is a transcript of the interview excerpt based on the task of drawing quadrilateral

AG085	P	"Dari gambar bangun segiempat yang berbeda-beda itu, sekarang saya mau tanya. Berapa banyak bangun segiempat berbeda yang dapat kamu gambar?
RS086	R	"Enam"
AG089	P	"Ada enam? Yakin?"
RS090	R	"Yakin"
AG091	P	"Tapi tadi kamu menggambar segiempat lebih dari enam"
RS092	R	"Iya, tapi A,B,C dan D itu sama-sama persegi panjang cuma yang membedakan hadapannya, posisinya dan ukurannya"
AG093	P	Jadi dengan memperhatikan perbedaan tersebut, kembali saya mau tanya Rani, kira-kira Rani bisa menggambar bangun segiempat berapa banyak yang berbeda?"
RS094	R	"Enam"
AG095	P	"Enam, mengapa mereka berbeda satu sama lain?
RS096	R	"Ada yang berbeda posisinya, ada yang berbeda bentuknya, hadapannya dan ukurannya.
AG097	P	"Jadi Rani bisa menyimpulkan dapat menggambar bangun segiempat berapa banyak?"
RS098	R	"Banyak"
AG099	P	"Banyak, maksudnya?"
RS100	R	"Tak terhingga"
AG101	P	"Kok bisa?"
RS102	R	"Karena kita bisa menggambar segiempat beda posisi, beda ukuran, dan beda bentuk dan putaran"

From the transcript of interviews and the results of drawing quadrilateral above, data showed that the subject can draw various kinds quadrilateral by taking into differences in the difference of position, size, shape and rotational symmetry.

The activities of subject when identifying the differential quadrilateral, subjects pays attention three attributes of quadrilateral based on size of the side, kind of quadrilateral (trapezoid) and position While at identifying the same quadrilateral, subject attentioned attribute number of pairs of opposite sides and parallel, the angle of sight, the existence of a right angle which is owned by the rectangle and the size of both the adjacent sides or opposite sides and parallel. Definition of quadrilateral which is made by the subject accurate and inaccurate depending on the definition of quadrilateral used as a reference in defining a quadrilateral.

Clearly explained that the subjects make inferences when:

a. Identifying Parallelogram

1. Student identifies several different models by taking into the attributes of size of parallelogram and the position of parallelogram.
2. Student identifies some of the same characteristics of parallelogram by regarding the attribute size of side and having two pairs of opposite sides parallel and opposite sides of the same length.
3. Referring to the definition of parallelogram is a quadrilateral of which two pairs of parallel opposite sides, or two pairs of opposite sides of equal length, or a pair of parallel opposite sides of the same length, then the attributes given by subject to construct a definition parallelogram is accurate.

b. Identifying Rectangle

1. Student identifies several different rectangular models by taking the atribute of size and the position of rectangle.
2. Student identifies a common characteristic of some rectangles that four corners is right angle, opposite and parallel sides equal in length.
3. Referring to the definition of a rectangle is a parallelogram whose one of the corners is right-angled, the attributes given by subject to construct a definition of the rectangle is inaccurate.

c. Identifying rhombus

1. Student identifies several rhombus in different models with regard to the attributes of size and position of the shape.
2. Student identifies a common characteristic of some rhombus that all sides of rhombus has the same length, opposite angle is equal.
3. If the definition refers to a rhombus is a quadrilateral whose four sides the same length as the attributes of a given by subject to build rhombus definition is accurate.

d. Identifying square

1. Student identifies some square in different models with regard the zise and position of the shape.

2. Student identifies the characteristics of some models of the same square i.e., all sides is equal in length and becomes right angel, opposite sides are parallel and equal in length.
3. If the definition refers to the square is rhombus which one of its angles is right angel or quadrilateral whose four sides the same length and the angle is right angel, then the definition given subject is inaccurate.

e. Identifying Trapezoid

1. Student identifies several trapezoids in different models with regard to side length and size attributes, position and the kinds of trapezoid.
2. Student identifies the characteristics of some models of trapezoids which have one pair of parallel opposite sides and the parallel sides of unequal length.
3. If the definition refers to the trapezoid is a quadrilateral having parallel opposite sides or rhombus which has only a pair of parallel opposite side, then the definition given subject is accurate.

f. Identifying Kites

1. Student identifies several kites in different models with regard to size of the kites and position of kites
2. Student identifies the characteristics of some models of kite is adjacent sides of the same length and opposite sides of unequal length, opposite angle is equal.
3. If the definition refers to a kite is quadrilateral that has two pairs of adjacent sides of the same length and the sides do not overlap, then the definition given by subject is accurate.

In the activities of making diagram of relationship between quadrilateral, subject made diagram relationships between quadrilateral as in Figure 3. The following

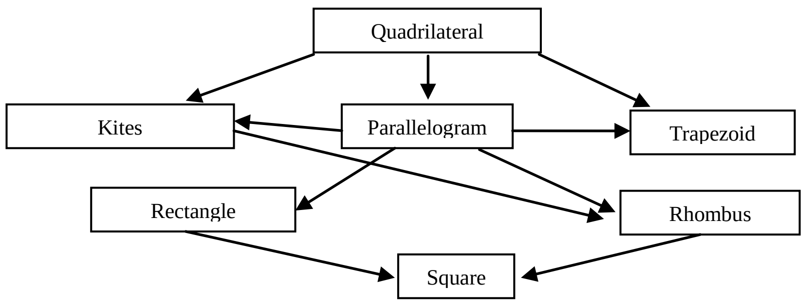

FIGURE 3. RELATIONSHIP OF VARIOUS TYPES OF QUADRILATERAL MADE BY SUBJECT

IV. CONCLUSION

From the results of this study concluded that:

1. If it is viewed from the standpoint of analytical, the definition made by subjects who is at the late formal operation presents relationship 7 relationships between quadrilateral possible. Shrinkage occurs relationship of 7 who may be 15 possible relationship. This shrinkage occurs because there is a genus that are used but not genus proksimum
2. Based on the understanding which is recognized by the subject who is at the stage of late formal operation, trapezoid is a quadrilateral which has a pair of parallel sides and a kite is a quadrilateral which is two pairs adjacent sides has the same length, then these results can be interpreted that the subject makes sense analytically.
3. There are 21 possible relationships between quadrilateral parallelogram, rectangle, rhombus, square, kite, and trapezoid. From 21 of this relationship, there are only 12 probably connections which is made by the subject, it is caused by definition trapezoid is a quadrilateral which h as opposite sides parallel and equal in length.
4. Subject recognized two accurate definition of 6 accurate definition which might and subject made 8 analytical definitions of 8 analytical definitions probably and 6 of them are accurate.

V. SUGGESTIONS

Based on these results, some suggestions have to be submitted as follows:

1. From the results of this research, in general student's understanding who is at the stage of late formal operations can understand the relationship between quadrilateral well but is less able to pay attention to or identify the relationship both similarities and differences of quadrilateral. Therefore, the researchers suggested that the educators must pay attention the stage of cognitive development of students in learning, particularly in understanding the relationship between quadrilaterals.
2. In the activities drawing quadrilateral. There is student's tendency, in this study, to draw a quadrilateral by starting from images that is very familiar for subject or often encountered and recognized by subject as a rectangle and a square. Likewise, when subject made diagram relationship between quadrilaterals, the tendency was happening again. Subjects tended to start from rectangle and connect it to the square. This indicates that the learning process in schools especially for quadrilateral, teachers often taught students ranging from rectangle or square so that students are only very familiar with both of them. Therefore, researchers also suggest to educators to teach not only the quadrilateral from a square or rectangle but start another quadrilateral such as parallelogram, rhombus, kite and trapezoid.

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ME – 04

Adaptive Reasoning and Strategic Competence in Solving Mathematical Problem: A Case Study of Male-Field Independent (FI) Student

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Abstract-Adaptive reasoning and strategic competence are two important components that can be assembled into a logical steps in solving mathematical problem so that they reflect a math proficiency. This paper describes the adaptive reasoning and strategic competence of student in solving contextual mathematical problem designed to involve settlement through some mathematical concepts and efficient strategies to formulate, represent, and solve problem situation. Cognitive styles and gender of students are assumed to make an impact on mental activity student in solving mathematical problems involve adaptive reasoning and strategic competence. Thus, in depth interviews carried out to a eleventh-grade male senior high school student and has cognitive style Field Independent (FI). Male-field independent (FI) student related the concept of mathematical to situation mathematical problem encountered clearly and completely that appropriate with the rules of the concept. In addition, male-field independent (FI) student used reading and imagining strategies in understanding the problem situation, used verbalizing strategy in formulating the problem situation, used imagining, symbolizing and verbalizing strategies in representing the problem situation and then solved the problem analytically.

Keywords: a*daptive reasoning, field Independent, gender, mathematical problem solving, strategic competence*

I. INTRODUCTION

This paper presents the investigation of adaptive reasoning and strategic competence in solving mathematical problem. Kilpatrick [1] revealed five strands that are entwined shaped mathematical proficiency. The five components are conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. Five strands are not independent, but rather entwined form a bond with each other and influence each others to establish mathematical proficiency. This suggests that the two strands of the adaptive reasoning and competence strategies also influence each other. Adaptive reasoning and strategic competence are two key component that reflect understanding of mathematics [2]. Both adaptive reasoning and strategic competence respective have many aspects that are assembled into a logical sequence in solving mathematical problem.

Adaptive reasoning refers to mental activities adapt mathematical concepts, facts, procedures, and methods into mathematics problem situation and than provide explaination, justifying and reflection regarding relationship between concepts and situation. Strategic competence refer to mental activities apply strategy to formulate, representate, and solve the problem situation [1]. Having an excellant adaptive reasoning and strategic competence, means that the students have been successful in learning and has established a mathematical proficiency. The realization of success in learning is not only seen on the ability of students to arrived to solution of the mathematical problem, but is also capable of logical thinking to provide an explanation and justification of the results of their thinking and strategy of solutions used in the process of mathematical problem solving. As the opinion of Kilpatrick[1] and Herbert [3] that every experience in solving problems, students should also be able to think logically to explain and justify each of solution and results of their thinking to others. According Skemp [4] that knowing something is done without a coherent reason is a form of instrumental understanding. Then

Skemp [4] identified the primacy in mathematics learning is to build understanding of "relational" than understanding "instrumental".

The tendency of students through the process of mental processing information to produce a solution of the problem situation is called cognitive style. According to Kuo [5] that cognitive style refers to how the tendency of individuals to organize and represent information. According to Leng [6] that describes how the cognitive styles of students to recognize and represent a problem, plan, produce and execute a plan, determine and evaluate the solution when students think about how to solve the problem-solving task. Cognitive styles directly related to the thought processes which form the results of his thinking in accordance with the characteristics of the student. Field-dependent (FD) and field-independent (FI) cognitive style is one dimension of cognitive style that most attention in the educational implications [7]. According to Kuo [5], FI student is internally directed and process information with their own structure, analyze problems that require all elements in the context, as well as accept the idea reinforced through prior analysis. Holmes [8] concluded FI Students set their own standards for thinking and behaving. FI students active and goal oriented. FI students have excellent logical reasoning and analytical reasoning skills. According to Johnstone and Al-Naeem, FI students can capture the essence of the problem and ignore unimportant information that is not excessive in processing information [9]. FI students demonstrated the ability in solving problems better than FD students [10].

Gender in this study are the characteristics that distinguish between male and female are shaped by social and cultural factors and biologically formed. The results of research related to gender differences are very diverse [10]. In general, mathematics achievement of male better than the mathematics achievement of female [11],[12]. Hyde, Fennema, and Lamon expressed that male outperform female in terms of solving complex problems [13]. The research results of Awan [14] states that female students significantly have math self-concept more positive than male students. But contradict with the research results of Hergovich [12] that males showed higher self-concept in mathematics and females have higher self-concept in language. Therefore, in this study unique investigate the male-Field Independent (FI) student in order to present the description of adaptive reasoning and strategic competence in solving mathematical problem.

Adaptive Reasoning is mental activity to relate mathematical concepts, facts, procedures, and methods into mathematical problem situations so as produce an idea that used to solve mathematical problems. Mental activity in the reasoning adaptive can be observed through: mental activity to relate concepts into problem situations by explain logically their relationship; mental activity to select procedures and methods that appropriate with the situation problem by explaining logically the procedures and methods; mental activity to adapt between mathematical concepts, facts, procedures, and methods and the situation problem by justify logically [1],[3],[15],[16],[2].

Table 1. Adaptive Reasoning in Solving Mathematical Problem

Aspect	Sub-aspect	Sub-aspect observed
Explaining	Selecting concept	• Selecting appropriate mathematical concepts with problem situations
	Explaining the relationship	• Explaining the relationship of mathematical concept with the problem situation
	Explaining strategy	• Explaining strategy that has been selected
	Explaining procedure	• Explaining procedure of the strategy that have been selected
Justifying	Justifying strategy	• Justifying strategy that have been used

Strategic competence refer to mental activities apply strategy to formulate, representate, and solve the problem situation and than looking back. Mental activities in strategic competence can be observed through: mental activities use strategy for understanding the problem situation; mental activities use strategy for formulating known information from problem situation; mental activities use strategy for formulating unknown information, mental activities select strategy/method as a solution; mental activities use strategy for representing problem situation that appropriate with method or concept selected; mental activities use strategy for solving the problem [1],[16],[2],[17].

Table 2. Strategic Competence in Solving Mathematical Problem

Aspect	Sub-aspect	Sub-aspect observed
Formulating	Selected strategy for Understanding	• Selected strategy for understanding the problem
	Formulating known information	• How is the strategy used for formulating data / information is known from the problem situation
	Formulating unknown information	• How is the strategy used for formulating data/information is unknown from the problem situation
Representing	Selecting methods	• Selecting methods as a solution
	Representing problem situation	• How is the strategy used for representing problem situation that appropriate with method or concept selected
Solving	Solving problem	• How is the strategy for solving the problem

II. METHODOLOGY

This study employed qualitative research methods. The goal of the study was to present an accurate description of real situation regarding aspects of adaptive reasoning and strategic competence rather than simply asses mathematics expertise observed from the male-field independent (FI) student in solving mathematical problem. This subjek has a high mathematics achievement, that was known from given the test mathematics competence. This test arranged from nasional exam questions in 2013, 2014, and 2015 that have been converted into essay questions. Furthermore, subject also have been given GEFT (*Group Embedded Figures Test*) test to know that the subjek is field Independent student. This subject is eleventh grade student.

Since the aim of this study to examine the adaptive reasoning and strategic competence rather than simply asses mathematics expertise, it was necessary to supply a nonrutine problem that would challenge the student and was suitable for the study of adaptive reasoning and strategic competence. Nonrutine problem refer to a task that the student has not previously seen and done problem. The problem involve some mathematical concepts as settlement and need an efficient strategiy. The nonrutine problem given is as follows:

There is a land size $(200 \times 200)m^2$. Within the land there is a warehouse size $(40 \times 40)m^2$, which is located in center of one edge of the land and overlooking the land. The whole piece of land overgrown with greengrass and dense, except on the warehouse. An lawn mower has a cable length of 80 m. On the walls of the warehouse in right front corner there is an electricity source to turn on the lawn mower. Determine the area of land that allows the grass can be mowed?

Student were given nonrutine problem above and then interviewed in solving the mathematical problem. Subject was investigated to express his thingking regarding all aspects of adaptive reasoning and strategic competence in solving the problem.

To obtain credible data that what is observed in accordance with the fact that the credibility examination technique is done using triangulation of time. Examine the results of the interview data from a subject at different times. In addition, this research data partially obtained by using handycam and voice recorder and field note.

III. RESULTS

Next section discuss the contribution of this study on how adaptive reasoning and strategic competence in solving mathematical problem for male-field independent (FI) student. The following all aspects from adaptive reasoning and strategic competence are assembled into a logical steps in solving mathematical problem.

A. Selected strategy for understanding the problem

Subject understand the problem situation using a reading strategy then imagine it. Subjek spent approximately two minutes to understand the problem situation. Subject read the problem calmly without touching the sheet of problem stored on the table. Before the two minutes was up, the subject then smiled as he continued to read about it. This indicates that the subject read the questions and then imagine easily. After reading, the subject received the information and then formed a mental image. Subject looked sure have understood the problem situation.

B. Explaining and justifying strategy that had been selected

Subject explained and justified strategies that was used to understand the problem situation with confidence that the strategies was appropriate. Subject used reading strategy then imagined the problem situation to be able to know and see all information of the problem. The information consist the core and aim of the problems encountered. The core problem is something which is the base to arrive at a final solution. The aim of the problem is the direction on what to do. Thus, the subject could understand problem situation after going through the process of receiving information from a problem situation and then through the process of forming mental images so that they can see and know the essence of the problem and the aim. Subject justified reading and imagining strategies for understanding the problem situations because they were a common and the right way to direct what should be done.

C. How was the strategies used for formulating data/information is known and unknown from the problem situation

Subject formulated data was known and unknown from problem situation verbally. Subject disclosed information that was in a problem situation with recounted all the information of the situation using his own words without looking at the text of the problem. Each sentences were recounted by his own words to make image clearly. The situation of problem were understood than subject recounted by his own understanding. The subject also illustrates the situation with using paper as a land and his fingers as a warehouse.

D. Selecting appropriate mathematical concepts with problem situations and explaining the relationship of mathematical concept with the problem situation in understanding the problem situation

Initially, subject select concepts of square area and circle as concepts that appropriate with problem situations. Subject explained that land and warehouses has form square. The land was said to be square because the land has the size $(200 \times 200)m^2$. Which means that land has the same length is 200 m. Writing the size of square is “side multipled side”. As well as the warehouse also was said to be square because the warehouse has the size $(40 \times 40)m^2$that means has the same length is 40 m. The subject also explained that the concept of a circle has relationship with the problem because based from the problem situation that there was a lawn mower has a cable length of 80 m. Then will be found land area that allowed the grass cut by the lawnmower. Subjects used a pen then rotated one end and the other end have support on one point. Subject explained that if for example this pen is the cable length then land area that can be passed by the lawn mower is like this pen that is rotating in a circle with the electricity source as the center and the cable length as radius.

Subject explained that the electricity source as center point because the electricity source attached to the wall that can not be moved (fixed point). Then subject also explained that the cable length as radius because radius are connecting between the center to the edge or side of the circle. While the cable length is connecting between electricity source dan lawn mower, so that the lawn mower is limited mobility and can only in a circle.

E. Selecting methods as a solution

After understanding the problem situation, furthermore subject was asked to demonstrate how to solve the problem. Subject later imagine before drawing all the information received from the problem situation. At this stage of the representation of the problem situation, the subject has not immediately found the right solution. Initially, the first subject expressed will calculate the area of the warehouse first and then calculate the area of land overgrown with grass. After that, the land area is reduced to the warehouse area. Then, to calculate the area of land that grass can be cut by the lawn mower,and then subject drew a circle with radius of 80 meters with its center at the front corner of the warehouse. Subject sure that the grass inside a circle with a radius of 80 can be mowed by a lawn mower. The subject then make a new draw regarding all of the information contained in the problem situation. Subject drew only used a pen without using a drawing tool. Subject considered the size of the current drawing although not using the right scale.

F. How is the strategy used for representing problem situation that appropriate with method or concept selected and explaining strategy that has been used and explaining procedure

Figure 1. The subject's representation of problem situation

Subject was asked: *In what way you further solve this problem?* Subject make and produce a picture above (see figure 1). Subject representated the problem situation with make two square area, one are as a land with side length is 200 m and the other square as a warehouse with side length is 40 m . Subject also representated two circle, one circle with radius 80 m and the other circle with radius 40 m. Subject explained that circle with radius 80 m formed from the cable length. Circle with radius 40 m formed from remain of the cable length beyond the front wall of the warehouse with it's length 40 m, so that the length of remain is eighty minus forty equal forty meter and form a quarter circle with radius of 40 m. All part of the quarter circle exist in land area. Subject explained that the area of the land that it's grass allows mowed by lawn mower is composed of a half circle with radius 80 m, a quarter circle with radius 40 m, and an area that placed at right of the warehouse.

Subject were asked: *How your procedure to complete the area to look for*! Subject explained the procedure, first, calculate the area of a half circle with a radius of 80 m. Second, calculate the area of a quarter circle with radius of 40 m. Third, calculate the area of rectangular that it's sides 40 m multiplied by 80 m.

Furthermore, subject were asked*: How do you calculate the area of rectangular that it's sides 40 m multiplied by 80 m?* Subject think about 5 minutes. After that, subjek make a line that divides the that area so as form a right-angle triangle and a sector. Then make another high line in the area of sector as shown in figure 2.

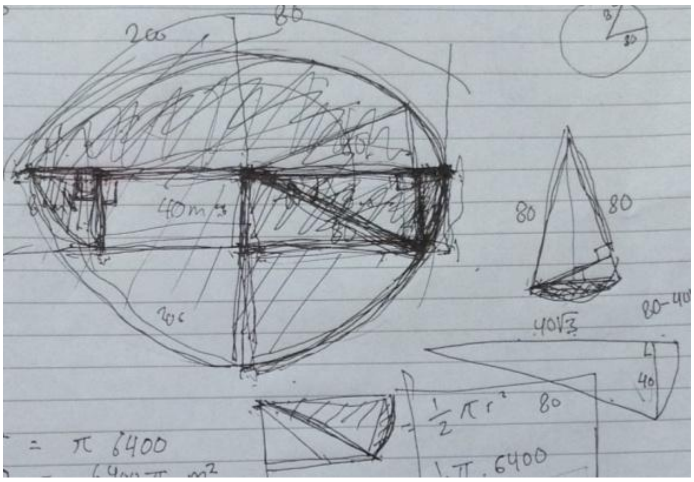

Figure 2. Student's Representation by Picture

G. Justifying strategy that have been used

Subject justify strategies used verbally and used of picture aids. His justification in accordance with the rules and properties concepts related . Subject divided the land area which allows the grass mowed by the lawn mower into four parts, namely a half circle with radius of 80 m, a quarter circle with radius 40 m, a one over twelve of the circle with radius 80 m and a right-angled triangle. Subjects were asked: *why do you say that this is a half circle*? Subject justified a half circle picture with the aid of picture that has been made. His justification was that "Due its center point is here (pointing to the center point of a circle with radius 80 m). Whereas here (pointing straight line to the left from the center to the circle line) 80 m and same here (pointing straight line to the right from the center to the circle line) is also 80 m and if we draw the line from here (center) to here (one point on the circle line so that the line is perpendicular to two line that have been mentioned earlier) in length is also 80 m. If we also use the tool for draw a circle with the center here (pointing to the center) will inevitably result in a half circle ". The subject asked again: Is There another explanation to justify it? Subject to re-explain that “if we draw a full circle, then this section (pointing a half-circle section with radius 80 m) is a half circle because, it's cleavage, forming diameter.”

H. How is the strategy for solving the problem

Subject was asked, "How do you solve this situation?", Then subject watched carefully the picture that has been made. Subject focused on each part of the picture that would be solved, even by separating the part of picture from the overall picture to be able solved the situation properly. Although drew that section separately repeatedly and took into account the size of the existing ones. After found the right solution, the subject later used a formula in accordance with the method used. Subjects completed the used of the formula to arrived at a final solution properly.

IV. DISCUSSION

Subject used strategies reading and imagining in understanding the problem. Subjects used strategies verbalize in formulating the problem situation. Subjects used the strategies imagining, symbolize and verbalize in representing the problem situation. Subject understood problem quickly because the subject managed to form mental images properly and appropriately. After imagined all the information captured from the problem situation, the subject admitted that he had understood the situation of the problem without have to draw these situations advance. Because obtain a good mental image of the problem situation, the subject feels confident that he has understood how the direction of what would has to be looked for and counted on the problem. The belief that the subject has really understood the problem, because the subject was able to retell a problem situation using their own language without seeing the text of the problem. Furthermore, subjects also immediately recognize quickly the concept that has the appropriate relationship with the problem, namely the concept of the circle. The subject was also familiar with other concepts quickly and appropriately during the process of solving problems. Subject provides an explanation of the relationship between the concept of a circle with a problem situation clearly. He explained all the parts of the circle associated with problem situations, such as radius, wide circle, center point, diameter, appropriately and in accordance with its nature. Subjects also justified the use of concepts and methods selected in conceptualization. From all that has been described above, it can be concluded that the subject has been linking "concept image" that has been owned by the understanding of the concepts that have been constructed since imange concept consists of "all of the mental pictures and associated properties and processes" [18]. For example, the subject explained that the cable length is appropriate with the nature of the radius because the radius connects the center point to the circle line while the cable length connects the electricity source with a maximum range of lawn mower. In addition, the subject explained that the electricity source is appropriate with the nature of the center point where the position settled at one point.

Overall, subjects correctly solve the problem until the final solution. The tendency of subjects complete the settlement procedures are analytically. For example, there is a part of the land area which also allows the grass mowed by the mower, as in figure 2. Subject analyze d this part first. And then the subject selected strategies to successfully find the wide of sector area. Based on that goal, the subject used drawing strategy three times with the size of each side in three different places. This shows that the subjects solve problems analytically. In accordance with the theory of cognitive style FI that the tendency of individual to use an analytical approach when processing information and goal oriented [5],[8] and capture the important parts of the information it received [9].

Subject provide explanations and justifications verbally and drawing on the concepts and methods used. Subject logically explain the relationship between concepts and problem situations. In accordance with the results of Holmes [8] that students FI has excellent logical reasoning. The subject also provides an explanation and justification clearly and always feel confident with his explanations and justifications. Students are confident because in every process through in solving the problem always use mathematical concepts, facts, procedures and method that appropriate. In accordance with the expression Kilpatrick [1] that the process of adaptive reasoning holds all the facts, concepts, procedures, and methods of mathematics to steer arrive at a right final solution. In addition, the subject was always sure and confident in solving the problem because according to the research results Hergovich [12] that boys have high math self concept.

V. CONCLUSIONS

This study focus to the aspects of adaptive reasoning and strategic competence from male-field independent (FI) student in solving the mathematical problem. Male-field independent (FI) student formulate the problem by revealing the data of known and unknown verbally. Understanding the problem situation by reading and imagining and without making a picture of the problem situation. Recognized the concepts that appropriate to problem situations quickly and precisely. Selected drawing method and then represented a problem situation by drawing all information that received and then create a symbol of mathematical formula. Explaining the relationship between concept and problem situations logically, complete and correct. Justifying the used of concepts and methods logically with full confidence. Male-FI student also solved problems right up until to the final solution of the problem completely.

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ME – 05

The Characteristics Of Students' Refractive Thinkingabout Data

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Abstract—Refraction is the process of produced the decision through reflection and critical thinking. Therefore, thinking that characterized by reflective thinking towards critical thinking until produce a decision called a refractive thinking. This shows that an important component of the refractive thinking is reflective thinking, critical thinking and a product. The reflective thinking is a process that occurs when a person encounters perplexity and conducted an investigation to find a solution. While, critical thinking is a process construct an alternative solution and evaluate various alternatives that can be considered to produce a decision. This study aimed to classifies the characteristics of students' refractive thinking about data. The approach used was a qualitative approach. The data source is the students of the 2nd semester by considering his communication skills. In this study, the students are required to complete the task and revealed with think a loud. If the student encounter reflective thinking and critical thinking in making decision, then students were included in the group of refractive thinking. The results showed that there were three characteristics of the refractive thinking performed by the students, namely: (1) the refractive thinking with a single strategy, (2) the refractive thinking with a dual strategy, and (3) the refractive thinking with multi strategies

Keywords:*refractive thinking, reflective thinking, critical thinking, data*

I. INTRODUCTION

Data considered as "number" [1]. In this case, data is not viewed as information on the specific situation about decision. Consequently, students always using statistical procedures to solve it, such as count the average or sum without attention of context provided. This proved with research [2] that some students in processing data by means comparing average or sum in making decisions about "most favored of cafeteria food". Some phases of completion to avoid misleading, among other: interpretation, description, conjecture, explanation and evaluation [2]. In view of [3] and [4] that descriptions and interpretation developed by [2] is the phase of reflective thinking. In the other, [5] and [6] identified that conjecture, explanation and evaluation are phase of critical thinking. Thus the phase of completion developed by [2] consists of two processes, namely reflective thinking and critical thinking. [7] and [8] defines that process produce a decision through reflection and critical thinking called refraction. Therefore, thinking that characterized by reflective thinking towards critical thinking until produce a decision called a refractive thinking. This indicates that a important component of refractive thinking is reflective thinking, critical thinking and decision.

Reflective thinking is one of the important thought process in construct knowledge and experience. The reflective thinking signed with difficulty (trouble) experienced by person so that he/she doing continuously behavior changes. Behavior changes are the process of investigated with explore information on the problem [9]. Investigations done to resolve the situation of uncertainty, instability, uniqueness, and conflict so that as provide answers the questions [9]. Reflective thinking occurs because of process connected one's knowledge with new information. This is matching with opinion of [3] and [10] that reflective thinking is process take knowledge and experience it then used to resolve problem. Reflective thinking is process occurs when person experienced perplexity and doing investigation repeatedly until finds completion [11]; [12]; [13]; and [14]. Perplexity are uncertainties or difficulties when solving problems. Inquiry is activity repeatedly searching for information that leads to settlement the problem. Reflective thinking has important role, namely as tool someone to solve the problem. With the thinking, can provide an opportunity for someone to step back and think about the best strategy to achieve goal [15] and [16]. Thus, reflective thinking is very important because it can help develop strategies and apply new knowledge the complex

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situations. If reflective thinking done right, then help person to next step which called critical thinking [7] and [8].

Be related with critical thinking, [7] that critical thinking signed with process of evaluated a variety of relevant information when doing reflection in the problem solving. Implicitly "evaluation" revealed [7] is process of selected alternative solution obtained thus be taken consideration to decision making. It shows that decision must based on relevant information or attributes the problem. This is mismatch with the opinion [17]; [18] and [5] that critical thinking is process of considering and evaluating of some information obtained so that possible to decision making. Critical thinking signed with activity interpretation and evaluation of the problem solving[18]. Interpretation revealed the definition is process construct some settlement and produce an alternative solution. Moreover, the word "evaluation" is process of determining some-thing. Evaluation is a process signed with selected solution or best answer from some alternatives [5].

Some researchers have review the reflective thinking as process towards critical thinking, among others: reflective thinking is the one tool to develop higher-level thinking [19]; critical thinking is the result of one's reflection in learning [20]; reflective thinking to support critical thinking skills in solving social and political problems [21]; reflective thinking increases one's critical thinking and understanding which learned [22]; reflective thinking the beginning of the process of critical thinking specifically refers to the process of analyzing and making judgments [23] and [24]; Reflective thinking is the key of critical thinking [23]. In the study, [2] showed the students experienced when using phase shift in thinking reflective thinking and critical thinking so as to produce variations of the model answers. However[2] did not review how the thinking of students in produce the answer. Whereas [7] write a study of refraction theoretically and not review in the mathematics education. In the research have not provided description about how process of reflective thinking continued to critical thinking till produce decisions. Therefore this article review the process of reflective thinking towards critical thinking till produce decisions called as refractive thinking

II. LITERATUR REVIEW

A. Definition of Refractive Thinking

Using a metaphor light to describe the refraction [25]. Refraction is process light hit a medium thus result reaction which triggered the refraction of light towards a certain point. Based on the metaphor, [7] and [8] states that the refraction occurs because of the reflection continued critical thinking and produce new knowledge. Therefore thinking is signed with reflective thinking continued critical thinking till produce decision called refractive thinking. This indicates that an important component of refractive thinking is reflective thinking, critical thinking and decision (product). The process of refractive thinking can be illustrated in Fig 1.

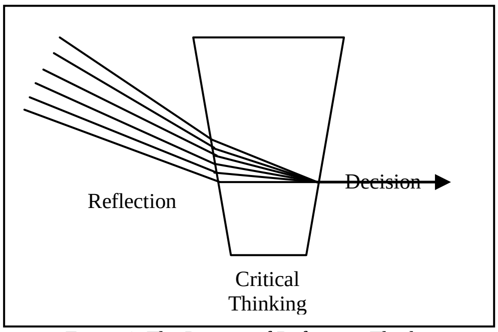

Figure 1. The Process of Refractive Thinking

Based on the illustration, process of refractive thinking occurs because of the process reflective thinking continued critical thinking until produce decision. This indicates that important component refractive thinking is reflective thinking, critical thinking and decision. The refraction is the transformative knowledge that occurs the which validates the use of critical analysis and problem solving providing interpretation and Conclusions of important issues and situations considering the course content and context [7]. Knowledge transformative in this case is ability of person resolve problems through some alternative solution. The purpose of refraction is process decision-making by considering some possible alternative solution. This shows that the refraction is focusing of information since there are some alternative solution obtained when reflection and do critically analysis as consideration to establish a decision. Be related with refraction, [8] defined that refraction is new knowledge acquisition from critical thinking of reflection. This shows that the refraction is the process of acquiring new knowledge (decision) resulting from reflection and critical thinking. Therefore refractive thinking this study is process of decision making through reflective thinking continued with critical thinking

B. Reflective Thinking

Basically, component of reflective thinking implicitly contained in the notion of reflective thinking. To make component ofreflective thinking determined beforehand some notion of reflective thinking of some of the views. The reflective thinking is a process occurs when someone experiencing perplexity and then conducting an inquiry repeatedly until find the solution [11]; [12]; [13] and [14]. Based on some notion reflective thinking, implicitly important component of reflective thinking namely perplexity and investigation.

Reflective thinking is initiated by the perception of something troubling or promising, and it is determined by the production of changes one finds on the whole satisfactory or by the discovery of new features which give the situation new meaning and change the nature of questions to be explored [9]. This shows that, reflective thinking signed with difficulty (trouble) experienced byperson so that he doing continuously behavior changes. Behavior changes are the process of investigated with explore information on the problem. Investigations done to resolve the situation of uncertainty, instability, uniqueness, and conflict so that as provide answers the questions. Based on the above definition reflective thinking, implicitly there are some components of reflective thinking. Components of reflective thinking according to [11]is perplexity and inquiry. According to [9] is the trouble and experiment. Two opinions can be compared. The equality of reflective thinking [11] and [9] presented in Table 1 below. Implicitly, Based on the similarities in the nature of each component, the obtained result of the development of reflective thinking in this article.

Table 1. Development of Reflective Thinking

[11]	[9]	[26]
Perplexity Uncertainty about something that is difficult to understand.	*Trouble* Difficulties experienced by someone	*Perplexity* Difficulties experienced person to continue the next process; doubts about the answer or solution is found or confusion when someone obtained unexpected results
Inquiry The process of repeatedly information that directs the mind to a certain direction.	*Experiment* Investigations conducted by exploring information to obtain an idea to solve the problem..	*Investigation* An investigation by exploiting existing knowledge to look back information or settlement process because of a uncertainty or doubts in obtaining answers

The table 1 shows a comparison of reflective thinking [11] and [9], namely: (1) Trouble partial indicator illustrated also in perplexity, such as someone difficulty in problem solving. Perplexity developed by Dewey is not just in trouble, but rather confirms the existence of doubt or lack of confidence their completion. If students are having trouble, doubt or confusion in solving the problem then it is said the students experienced perplexity; (2) Inquiry can be compared with the experiment, because the inquiry has the same properties as the problem that is causing the effort provide a solution. In the process of looking at the problem, a person can remember what you learned and utilized to solve the problem. The process is known as behavioral changes. In other words, students conduct an investigation by leveraging existing knowledge to look back the settlement process due to a lack of confidence or doubt in obtaining answers. Students who experience the process said investigation.Therefore reflective thinking in this article is the thinking process that signed the perplexity and then conducted an investigation till find a solution to the problem [26].

C. Critical Thinking

Critical thinking component is implicitly contained in the definition of critical thinking. To create a critical thinking component is determined in advance some notion of critical thinking of some of the views. [7] argued about critical thinking, Critical thinking demonstrates the ability to evaluate relevant information and opinions gathered in the reflection stage in a systematic, purposeful, efficient manner developing problem solving skills. This shows that evolution occurs because of the reflection of someone in solving problems. Thus the "Evaluate relevant information and opinions gathered in the reflection stage" which is revealed in the definition explicitly states that the evaluation and collection of some of the information is a component of critical thinking.

Be related critical thinking, [18] states that critical thinking is skilled and active interpretation and evaluation of observation and communication, information and argumentation. Critical thinking by [18] signed with interpretation and evaluation of information and statements. Usually Interpretation is construct and produce some solutions alternative. this is case, beginning to conclusions from problem. In addition, evaluation is process of determined something. Evaluation signed with selecting the most excellent of some alternatives [5].Based above definition critical thinking, implicitly there are some components of critical thinking. Components of critical thinking according to [18]interpretation and evaluation. According to [7] is Opinions gatheredand evaluation.Implicitly, Based on the similarities in the nature of each component, the obtained result of the development of critical thinking in this article.

Table 2. Development of Critical Thinking

[18]	[7]	[27]
Interpretation Construct some solutions and produce some alternative	*Opinionsgathered* Produce alternative possibility settlement obtained from some of the information collected	*The constructive activity* Constructing an alternative solution that leads to the answers or construction compare alternative
Evaluation Select the best of some alternatives	*Evaluation* The process of evaluating some alternatives settlement.	*Evaluation* evaluate settlement alternatives and answers the result by considering the relevant information.

The table 2 shows a comparison of critical thinking [18] and [7], namely: (1) Gathered opinions can be compared with the interpretation, because it has the same properties that produce alternative possibilities completion. The possibility of constructing an alternative solution requires a variety of information that has been collected in the process of reflection. The situation is known as construction (construct); (2) Evaluation of critical thinking [7] and [18] can be compared as in selecting or evaluating an alternative solution or answer. This component signed by evaluated alternative solution or answer based considerations. This component is known evaluation.Therefore critical thinking in this article is thinking process that signed the construct and evaluation alternative settlement and the best answer based on various considerations [26].

III. RESEARCH METHODS

The purpose of this study was to explored and classified the processes of students refractive thinking in solving mathematics problems. Refractive thinking indicated from the process of students construction against instrument task "decision-making". This study used a qualitative approach, since according to characteristics owned. The research was carried on students in 2nd semester. For this purpose, the research took the data on student at Universitas Wisnuwardhana Malang and Universitas Negeri Malang. Research subjects not randomly selected, However taken with considered his communication skills so disclosure of the thinking process can be done well.

In this study, students were asked to complete task and expresses out loud what he was thinking (Think Out loud) when solving problem. After students obtain settlement, research check the students process settlement correct to obtain answers. If student experience reflective thinking and critical thinking in produced decision, then student will be a subject and included in the group refractive thinking. Each group is filled by two research subjects. If not obtain the desired subject, then the given the task again to students. The process of selecting subjects performed until a saturation of the data, its meaning that appears the same or remain characteristics of some subjects for each category. The many research subjects for each reflective thinking is 2 subject. Determined 2 subjects, with consideration that the method analysis used the constant comparative method. The task sheet instrument "decision making" used in this research is the development of a decision-making instrument from [2]. Problems in this article are influenced by quantity and quality that is large and increase of numbers each object. The problem given to the students as follows.

Local Revenue Officessurvey 6 district to find out the level of district dependence on the central government. The dependence of regional on the central government can be measured based contribution the Own-Source Revenue (OSR) to income of province. If the contribution of OSR greater and increasedthen the district dependence to central government is getting low. The value in table below shows the percentage contribution of OSR to income of province based Natural Resources (NR) for three years.

NR \ District	A			B			C			D			E			F		
	Th. 1	Th. 2	Th. 3	Th. 1	Th. 2	Th. 3	Th. 1	Th. 2	Th. 3	Th. 1	Th. 2	Th. 3	Th. 1	Th. 2	Th. 3	Th. 1	Th. 2	Th. 3
livestock	*19*	*9*	*19*	*12*	*24*	*15*	*14*	*22*	*17*	*23*	*14*	*23*	*21*	*15*	*14*	*11*	*16*	*12*
Maritime	*18*	*20*	*13*	*9*	*19*	*19*	*12*	*23*	*17*	*24*	*8*	*8*	*19*	*12*	*19*	*18*	*18*	*24*
Forestry	*20*	*15*	*19*	*13*	*18*	*18*	*17*	*19*	*15*	*23*	*13*	*11*	*18*	*18*	*10*	*9*	*17*	*27*
Plantation	*9*	*11*	*26*	*23*	*17*	*14*	*20*	*22*	*15*	*17*	*16*	*14*	*16*	*24*	*15*	*15*	*10*	*16*
Agriculture	*25*	*14*	*20*	*14*	*13*	*15*	*19*	*15*	*24*	*16*	*24*	*14*	*16*	*18*	*9*	*10*	*16*	*18*
Fishery	*12*	*23*	*8*	*19*	*14*	*24*	*7*	*13*	*9*	*15*	*16*	*21*	*24*	*9*	*23*	*23*	*25*	*15*

The brother task is determine the order of district from the lowest to the highest dependence on the central government! Give an explanation for your answer!

Figure 2. Instruments Task

IV. RESULTS AND DISCUSSION

In this article the author only describes refractive thinking 3 subject. Third of subject were grouped into three groups: group one is subject 1 (S1) called single strategy. Subjects were included in the group 2 is subject 2 (S2) called dual strategy. Subject were included in the group 3 is subject 3 (S3) called multi strategy.

A. Characteristics of Refractive Thinking With Single Strategy by Subject 1 (S1)

The process of refractive thinking, begins with perplexity S1 to settlement. S1 determine average of each district. Settlement by average used as strategy to determine order of district. S1 think that the settlement with average can be used solved to problem. In the process look for average, S1 describes problem into some parts. S1 completed the first district A, B until the F. Thus overall average of district is the same, i.e. 16,7%. S1 questioned again the average obtained is the same "evidently of average the same?". S1 suspect that the strategy has not been to solved the problem. S1 reading again problems and silent for long time. In this case S1 experienced reflective thinking [11] and [9]. S1 questioned "if the great contribution and increase then low dependence, how do it?". This show that S1 experience perplexity again when obtained average of the same. S1 think long time again and suspect of criteria "if the greater and increase contribution of Natural Resources then the district dependence to centre of lower".

Based on these criteria, then S1 used another settlement with summing the percentage of contribution per year. The process is due to determine the amount of contributions per year. This shows that, when S1 suspect that strategy cannot be used to solve problems, he tried another strategy to solve it. This shows, S1 experience a process of critical thinking [7] and [18]. S1 summing percentage contribution per year. To explore the thinking process of S1 when solved with sum the percentage contributions per year, the research performed interviews. S1 claimed that to determine order of the district, the first of summing contribution per year. The settlement is based on the criteria of "substantial revenue contribution and increased". To determine the order of the district, the first S1 determine the great of contribution then compared with other district to determine the decrease and increase of contribution every year. The following settlement by summed the percentage contribution per year done by S1.

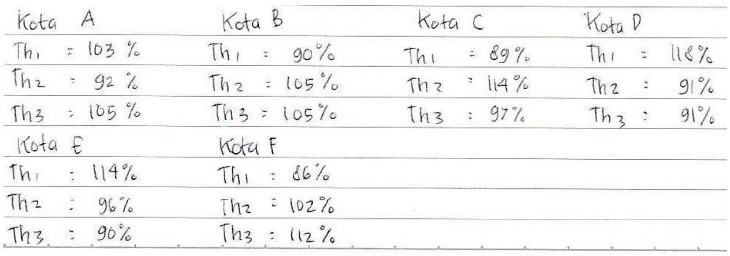

Figure 3. The result of students' (S1) work about summed the percentage contribution summed the percentage contribution

Process doing by S1 is grouping district of each year. S1 again shows the relations criteria "increase" with the amount of contribution each year "the great contribution and increased ..". The statement S1 aware that the criteria "increase" is the keyword to determine the order of the district. Implicitly, S1 can determine relations of the increase and dependency. S1 judging that the district has increased every year is district with low dependence while the district has decreased is an district with a high dependency.

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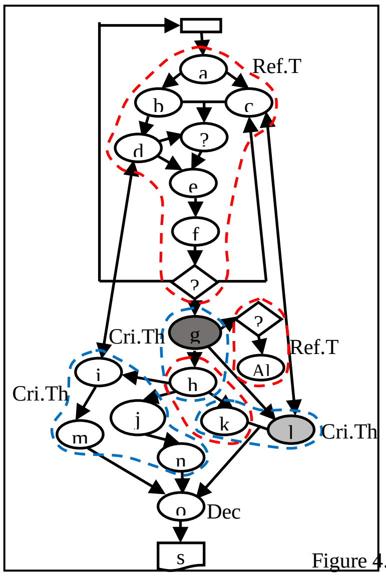
The next process, S1 experience critical thinking with identifying and comparing each district which has increased of contribution each year. Based on the amount of contributions obtained, S1 indicates the lowest dependence is district F. The process done with compared the district F and other district. F are considered to have significant increases each year. The next process second order. In the second order, S1 connect again and compared the increase in the amount of the contribution of each district. Based on the amount of contributions obtained, S1 shows second order of lowest dependence of district is the B. if compared with other district, District B has increase in the third year despite constant.In the determine third order, S1 distrustful is district A and C. S1 compared the great of contribution and the increase in district A and C. The district A occur decrease from the first year to the second year, then increase in the third year. The district C occur increase from the first to third year and then decreased in the third year. In the selection for third order, S1 experienced perplexity. S1 think again with to give an alternative settlement to indicate the difference between A and C. In the first year of district A is 103%, while district C is 89%, this indicates that the district A was excelled in the first year. While the second year, district A is 92% and C is 114%, this indicates that the district C was excelled. In the third year, district A was excelled as 105%, while district C is 97%, this indicates that the district A has a large amount of contributions for two years, while C is only one year. The next process is fourth sequences. S1 put district C as fourth sequences. District C is the comparator A when determining third order, however the district A was excelled compared to district C. Based on these, S1 puts district C as the fourth order. In addition, S1 was connected and compared the increase amount of contribution each district. If district C was compared to other regions (areas D and E), then district C was increased. In the fifth and sixth sequences , S1 only compared the two district that have not been occupied the previous sequence, i.e. D and E. The District D has decreased but the fixed in the third year. District E has decreased the amount of contribution significantly, that is the first year until third year in a row by 114%, 96% and 90%. District D as district that occupies the fifth order because amount of contribution the same that is second and third year is 91%. This shows that in the second year and third year, district D does not decrease (constant). Based on settlement process do by S1 in making decision about district sequence begin lowest to highest of dependence i.e. district F, B, A, C, D , and E. Conclusions are based on the criteria of "amount of great contributions and increased"

With these answers, S1 believes the answer. In the process of decision making, a subject need only one settlement alternative. Subject only to clarify the criteria contained in the problem as consideration to decide, for example, to identify the contribution of each year. Based on the thinking, S1 experienced refractive thinking with single strategy. The refractive thinking process by S1 can be illustrated in Fig. 4 below.

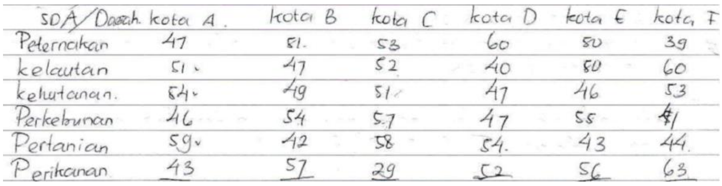


a	:	Sort district based on dependency
b	:	Contribution of NR increased every year
c	:	Lowest of dependency
e	:	The average contribution per year in each district
f	:	The result is the same
g	:	Summed contributions per year
h	:	Summing contributions every district
i	:	The amount of contributions increased
d	:	Remember
Ref.Th	:	Reflective thinking
Dec	:	Decision
Al	:	Other reason
j	:	The amount of contributions decreased
k	:	The amount of contributions dynamic (increase and decrease)
l	:	The amount of contribution increase each year
m	:	The increase in contributions from first year till third year
n	:	The decrease in contributions from first year till third year
o	:	The sort of district: F,B,A,C,D,E
s	:	Finish
?	:	Questioned settlement process
Cri.Th	:	Critical Thinking

Figure 4. The Refractive Thinking With Single Strategy by S1

B. Characteristics of Refractive Thinking With Dual Strategy by Subject 2 (S2)

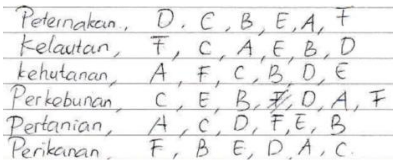
In the process of thinking, appears that S2 have difficulties to solve problem. S2 solved with summed the percentage contribution of each district based Natural Resources (NR). The process called analytical process, which is a process that describes the problem into several parts so that the parts are then completed. The summing is done by S2 begins by calculating the percentage contribution of livestock. S2 summing the percentage contribution of the farm for three years in each area. This process is carried out from the district A to district F.



SDA/Daerah	kota A	kota B	kota C	kota D	kota E	kota F
Peternakan	47	51.	53	60	50	39
kelautan	51	47	52	40	50	60
kehutanan.	54	49	51	47	46	53
Perkebunan	46	54	57	47	55	41
Pertanian	59	42	58	54.	43	44.
Perikanan	43	57	29	52	56	63

Figure 5. The result of students' (S2) work about summing percentage contribution of the farm for three years in each area

The District order first on the livestock is district D, C, B, E, A and F. This is because the amount of district contribution to livestock the greatest is district D i.e. 60, then district C is 53 and smallest amount is district F i.e. 39. While in maritime, district F is a district order first because it has the highest amount of contributions compared to other district i.e. 60. Then continue district C with contribution amount 52 and district last order is district D with contribution 40. The group process and sorted performed by S2 until fishery.



Peternakan, D, C, B, E, A, F
Kelautan, F, C, A, E, B, D
kehutanan, A, F, C, B, D, E
Perkebunan, C, E, B, ~~F~~, D, A, F
Pertanian, A, C, D, F, E, B
Perikanan. F, B E, D, A, C.

Figure 6. The result of students' (S2) work the group process and sorted until fishery

The next process, S2 combines the sequence a whole. In the process of combining sequences, S2 connects sequence with rank . It can be seen from the statement S2 ".... makes the rank first, A, B, C, D, E, F, and rank 1, 2, 3, 4, 5, 6". This indicates that S2 experience process of critical thinking[7] and [18].The statement indicates that the S2 explicitly show relationship of district with ranking. S2 connected ranking with district have greatest to smallest of contribution amount at each Natural Resources.

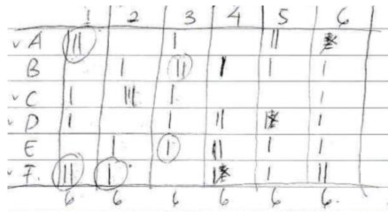
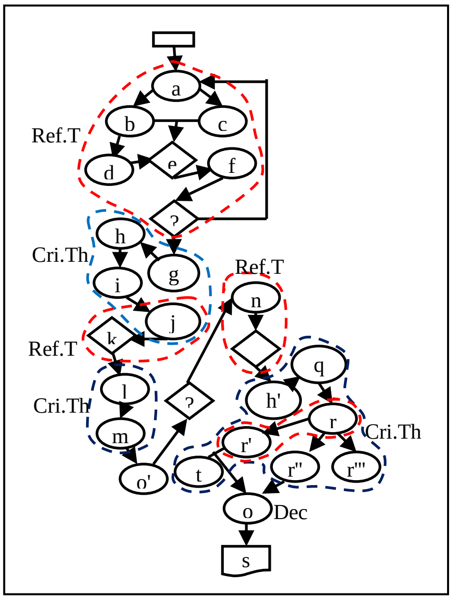


Figure 7. The result of students' (S2) work about connected ranking with district

Based on above settlement, S2 attention district that are above (first order). The first sequence of the district there are four choices of district A, C, D, and F. S2 connected one district to other district of sequence, in this case S2 compared district A, C, D, and F. Based on this comparing, many district (mode) the first sequence is same. District mode C and D is one, while district A and F is two. S2 compared A and F with sequence thereafter (second). In sequence afterward (second), mode of district F is one, while areas A no mode. S2 identify the sequence thereafter (the second) for consideration determining the first sequence. S2 choose F as district in first sequence, while A is chosen as district in the second. This is because the district A ranks first as much two and rank second as much three.The next process is third order. To determine the sequence of third, S2 compare district B, C, D and E. Based on four district, S2 comparing many district in the first sequence. In the first sequence that appears only district C and D as many one. Furthermore, S2 consider the order after namely the order of two and three.The next process is fifth. S2 looked back at remaining district, namely B and E. S2 connects the district B and E based on the second and third sequence. In the second sequence, district B as much one, while E as much one. Shows that the district have same mode in second order. S2 choose alternative of compared that is third sequence. District B in third order as much 2 while district E only 1. Based on settlement process, S2 make decisions about sequence from lowest to highest dependence on district F, A, C, D, B, and E. Conclusions are based on compared many district (mode) in certain sequence. The process of refractive thinking with dual strategy by S2 can be illustrated in Fig. 8 below.



a	:	Sorteddistrict based on dependency
b	:	The great contribution of OSR and increased
c	:	Lowest dependency
f	:	Summed the contribution of OSR per sector
g	:	Grouped of district per sector
h	:	Combining based amount of contributions
q	:	Connected with rank
i	:	Connected with sequence
j	:	Comparing district of particular ranks
l	:	Summed contribute to ranking of 1.2, and 3
e	:	Summed or divided
Ref.Th	:	Reflective thinking
Dec	:	Decision
m	:	The amount obtained different (large and small)
?	:	Questioning the settlement process
d	:	Remember
o	:	The sort of district: C,F,A,B,D,E
n	:	Summed the overall contribution
r'	:	Mode in a certain sequence
r''	:	The same of mode in certain sequence
r'''	:	The small of mode in certain sequence
t	:	Sequence mode before and or after
s	:	Finish
k	:	the same of sequence
Cri.Th	:	Critical Thinking

Figure 8. The Process of Refractive Thinking With Dual Strategy by S2

C. *Characteristics of Refractive Thinking With Multi Strategy by Subject 3 (S3)*

S3 represents contribution of the most widely with summed percentage contributions for three years. S3 added the percentage of each district from first to the third year on each Natural Resources
S3 using another settlement which connects with the sequence of points or score. The biggest scores indicate low dependence, whereas the lowest score showed high dependency. The first sequence district were the biggest scores, while the last order district was lowest score. S3 gives a score of 6, while final sequence given score of 1. This indicates that S3 integrates sequences with the scoring. The following settlement by S3 relating to the scoring.

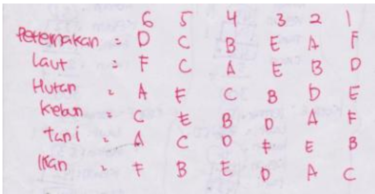


Figure 9. The result of students' (S3) about relating to the scoring

The next process, S3 summed scores each district. For example, the score of district A is 6,6,4,2,2,2 if the scores are summed obtained 22. The process of scores summed in each district until district F. The following results of work by S3 related to total score of each district.

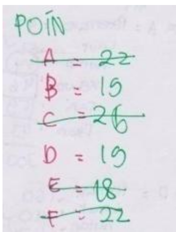


Figure 10. The result of students' (S3) about total score of each district

Based on the results work above, the lowest order first is district C. chosen C as the lowest order first by S3 because of some district, the district C has greatest amount of scores. This is consistent with previous statement by S3 *"The greatest contribution is the most low dependence"*. S3 feel confident with the first order is district C. This appears statement by S3 *"means the correct .."* The next process of the second order. S3 attention again the total score of each district. Based on the results work are district have the same amount in the second i.e. the district A and F. The total score of two is 22. This indicates that possibility of a second sequence is occupied by A and F, the following statement S3 *"A and F, here the twins, second chances if not A, yes F ".*

Based on the similarity score on A and F, S3 silent for moment and reading again the question. S3 experience perplexity in determine the order of second. The behavior appears with statement S3 "Then I see from where?.. we see from here highest (pointing Natural Resources) ". To determine the order of second, S3 consider many Natural Resources with a amount great contribution in A and F. District A, the Natural Resources has large amount is 4 (livestock, forestry, plantation and agriculture), while district F is 2 (maritime and fisheries). This shows that A has greater Natural Resources to contribute of district F. The following results of work by S3 related to many Natural Resources.

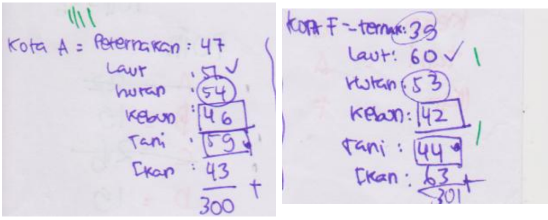
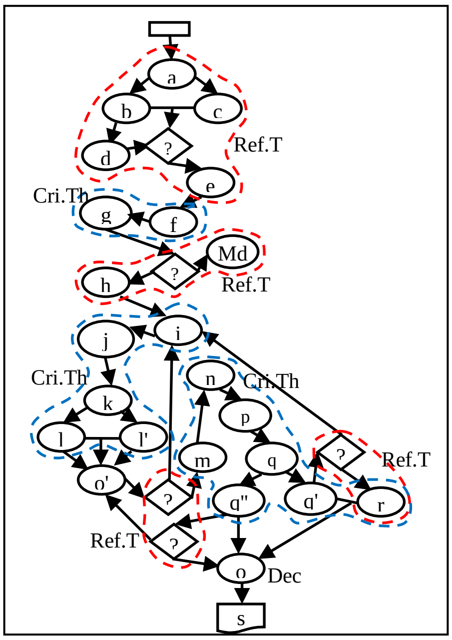


Figure 11. The result of students' (S3) about related to many Natural Resources

Based on the results work, then the second order and third is district A and F. This is because district A has more natural resources compare the district F. With these answers, S3 believes the answer. In the process of decision making, subject not only requires two strategies (addition and ranking), but he made another settlement (score) as reinforcement for answers obtained. Based on the thinking, S3 experience refractive thinking with multi strategy. The process of refractive thinking with multi strategy by S3 can be illustrated in Fig. 12 below.



a	:	Sort district based on dependency
b	:	The largest of contribution
c	:	Lowest of dependency
f	:	Summed contribution per sector in each district
g	:	Summed contribution of each district as a whole
d	:	Remember
Mdr	:	Other reason
h	:	Grouped ofdistrict per sector
j	:	Concluded overall order of district
i	:	Collect and sort district based on amount contributed of NR
q'	:	The total score is same
r	:	Many natural resources havegreat amount
Ref.Th	:	Reflective thinking
Dec	:	Decision
k	:	Identifying district on the first and second of three
l	:	Uniform distribution in various sectors
l'	:	Dissemination most areas often appear in front
o	:	The sort of district: C,B,D,A,F,E
m	:	Connect the order with ranking
n	:	Connectthe ranking with score, lower ranking given large scores; High rankings given small score
p	:	Classifying district with scores
?	:	Questioned settlement process
q	:	Summed scores on each district
q"	:	Total score of large and small
s	:	Finish
Cri.Th		Critical Thinking

Figure 12. The Process of Refractive Thinking With Multi Strategy by S3

V. CONCLUTION

From the results study to refractive thinking of students in solving mathematics problems can be concluded that there are three type processes of refractive thinking by students, namely: (1) refractive thinking with single strategy signed the process of decision making, a subject need only one settlement alternative. Subject only to clarify the criteria contained in a problem of consideration to decide, for example, to identify the contribution of each year, (2) refractive thinking with dual strategy signed the process of decision making, the subject need two alternatives. If there are sequence of district the same, subject uses internal comparison as consideration, for example considering the mode of sequence before and after, and (3) Refractive thinking with multi strategy with the process of decision making, subject need the settlement of three alternatives. If there are sequence of district the same, subject uses external comparison as considerations, for example identified many Natural resources with largest amount.

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ME– 06

Effectiveness Of TPS And SGD With Scientific Approach In Terms Of Problem-Solving And Self-Confidence

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Abstract-This study aimed to know the effectiveness of Think Pair Share (TPS) and Spontaneous Group Discussion (SGD) with scientific approach in terms of problem-solving and self-confidence. This study was quasi-experimental with pre-test post-test nonequivalent group design. The population consists of 101 students in grade X MIA MAN 1 Yogyakarta. Its samples were 34 students of X MIA class who gets TPS with scientific approach and 33 students of X MIA 2 class who gets SGD with scientific approach. The instruments were test instrument to measure problem-solving and non-test instrument which consists of scale to measure self-confidence and observation sheet to observe learning process. The results of this study with a significance level $\alpha = 0.05$ were : (1) The first experiment class problem-solving significant value is 0.000, therefore TPS with scientific approach is effective in terms of problem-solving. (2) The first experiment class self-confidence significant value is 0.006, therefore TPS with scientific approach is effective in terms of self-confidence. (3) The second experiment class problem-solving significant value is 0.000, therefore SGD with scientific approach is effective in terms of problem-solving. (4) The second experiment class self-confidence significant value is 0.039, therefore SGD with scientific approach is effective in terms of self-confidence, (5) Significant value of problem-solving comparison is 0.048, therefore TPS with scientific approach is more effective than SGD with scientific approach in terms of problem-solving. (6) Significant value of self-confidence comparison is 0.882, therefore TPS with scientific approach is as effective as SGD with scientific approach in terms of self-confidence.

Keywords:*self-confidence, problem-solving, scientific approach, TPS, SGD*

I. INTRODUCTION

Science and technology continue to evolve in line with the developments of education. Education consistently develops the potential of the next generation in order to become good human resources. These human resources will gradually create new discoveries which are important for human life. In Indonesia, the importance of a education role is conceived by designing the function and purpose of education [21] written on UU No. 20 of 2003. As an effort to achieve the goal, curriculum was created. The latest curriculum is Curriculum 2013. Curriculum 2013 is focused on character, knowledge, and skill [9]. Curriculum 2013 expects students not to only have a high ability but also cognitive skills and a good attitude or character.

In this curriculum, mathematics is one of the subjects that must be learned by the students. It is because mathematics helps people in developing the technology and science. According to Branca [2] problem solving is the heart of the mathematics. The consequence is students should learn this ability. The problems which are used to train students' problem solving ability must fulfill two criterias. According Herman Hujodo [5], the criterias are (1) the question should be understood by students but it is still a challenge for them. (2) The question can't be done by routine steps of problem solving. There are two kinds of problems which are problem to solve and problem to find [18]. In this study, type of the problem is problem to find. Problem solving expects students to follow a series of steps to find a solution. According to Polya [17] the series of steps are understanding, planning, problem solving, and rechecking.

Based on the Curriculum 2013 [9], standard graduation of attitude aspects are faith, nobility, self-confidence, and responsibility in interacting with social and natural environment. Based on this statement, it is known that self-confidence is very important. According to Lauster [10] self-confidence is an attitude or belief in self-ability so that the actions are not too anxious, feel free to do things as you wish and be responsible for his actions, be polite in their interaction with others, have the drive to recognize the achievements and the advantages and disadvantages. Self-confidence will lead people to achieve their success. In this study, aspects of self-confidence are belief in self-ability, internal locus of control, objective, responsibility, rational and realistic.

There is indication that students' problem solving ability and self-confidence in Madrasah Aliyah (MA) is not optimal. It is caused by the study load in MA is heavier than common high school. In MA, students not only study about common materials like in formal school but also materials about religion [8]. According to Slameto [16], the study load is one of the reason of the difficulty in learning including problem solving ability and self-confidence. This condition is agreed by student of MAN 1 Yogyakarta. They do not understand well the material because of the study load.

Based on the Regulation of the Ministry of Education and Culture No. 65 year 2013 [12] about the Standard Process, it is stated that the standard of learning in the Curriculum 2013 is using a scientific approach, integrated thematic, and thematic. Scientific approach is choosen to deliver mathematics concept. This approach adopts constructivism in which students are required to build their own knowledge. According to Daryanto [1] the scientific approach is a learning process that leads students to actively develop principles, concepts or laws through scientific steps. These steps are outlined in Regulation of the Ministry of Education and Culture number 81 A 2013 annex IV [13] and Regulation of the Ministry of Education and Culture number 103 2014 [14] which consist of: observing, asking, gathering information, associating and communicating. Thus, scientific approach will assist students in learning mathematics

There are many learning models which have been developed by experts. One of learning models is cooperative learning. According to Spencer Kagan & Miguel Kagan [7] cooperative learning is the most effective model to achieve the learning's goal. Cooperative learning has also been developed by experts so that there are many types of cooperative learning. Those types include Think Pair Shre (TPS) model and Spontaneous Group Discussion (SGD)

TPS learning models lead students to solve the problem following three steps. Those steps are think, pair, and share. TPS learning model helps the students to solve the problem individually before they discuss in pairs and present the discussion result. This condition improves students' problem solving ablility. According to Fogarty dan Robin [1] TPS learning model trains students to be brave in sharing their idea in front of the class.

SGD learning model leads students to solve the problem following three steps. The steps are grouping spontaneously and variously, discussing the problem, and presenting their discussion's result as the teacher calls each groups [11]. Conducting SGD learning model is easy because its learning process is simple. The discussion which had been done by five students allowed students to share their ideas each other to solve the problems. SGD learning model has also step of calling all group to present their discussion's result. It will improve students' self-confidence.

There is a consideration that TPS and SGD learning model combined with scientific approach can improve students' problem solving ability and self-confidence. TPS learning model combined with scientific approach leads students to solve the problem following steps of scientific approach in group using TPS model, therefore in the end of learning they discover a new concept of matehmatics. SGD learning model combined with scientific approach leads students to solve the problem following steps of scientific that is conducted trivially and spontaneously.

Based on the description above and the potential of the steps in TPS and SGD model combined with scientific approach, it is necessary to conduct a research about the effectiveness of TPS and SGD learning model combined with scientific approach in term of problem solving ability and self-confidence in MAN 1 Yogyakarta.

The problems in this study are described as follows: (1) Is the TPS learning model combined with scientific approach effective in terms of problem solving?, (2) Is the TPS learning model combined with scientific approach effective in terms of self-confidence?, (3) Is the SGD learning model combined with scientific approach effective in terms of problem solving?, (4) Is the SGD learning model combined with scientific approach effective in terms of self-confidence?, (5) Which is more effective between the TPS learning model combined with scientific approach and SGD learning model combined with scientific approach in terms of problem solving?, (6) Which is more effective between the TPS learning model combined with scientific approach and SGD learning model combined with scientific approach in terms of self-confidence?

The purpose of this study are: (1) to describe the effectiveness of TPS combined with scientific approach in terms of problem solving abilities, (2) to describe the effectiveness of TPS combined with scientific approach in terms of self-confidence, (3) to describe the effectiveness of SGD combined with scientific approach in terms of problem solving abilities, (4) to describe the effectiveness of SGD combined with scientific approach in terms of self-confidence, (5) to describe which one is more effective between TPS combined with scientific approaches and SGD combined with scientific approach in terms of problem solving, (6) to describe which one is more effective between TPS combined with scientific approaches and SGD combined with scientific approach in terms of self-confidence.

The benefits of this study for the teachers are (1) getting alternative of learning models to apply the scientific approach, (2) getting reference to improve students' problem solving ability and self-confidence, (3) helping the teacher in conducting an interactive and effective mathematics learning. The benefits of study for students are: (1) students are able to improve their ability in problem solving, (2) students are able to improve their self-confidence, (3) students are able to improve thir ability in sharing their idea.The benefits of this study for researchers is getting direct experience of the researcher as a potential educator in implementing the learning model and its influence in terms of problem solving and students' self-confidence

II. METHOD

This research was a quasi-experimental research, a study used to estimate the causal impact of an intervention on its target population. This study was conducted at MAN 1 Yogyakarta, Indonesia, in the first semester of academic year 2015/2016. The material in this study was Sequence and Series. All students in grade X MIA MAN 1 Yogyakarta which consists of 101 students is used as population. The sample consists of two classes which had been chosen randomly with cluster random design. First experiment class was X MIA 3 which consists of 34 students and the second experiment class was X MIA 2 which consists of 33 students. This study used three variables: independent variables, dependent variables, and control variables. The independent variables were cooperative learning model with two variations types; they were Think Pair Share (TPS) learning model and Spontaneous Group Discussion (SGD) learning model. Both of types were combined with scientific approach. The dependent variables in this study were problem solving ability and students' self-confidence. The control variables in this study were allocation time of learning process, the teacher, and sequence and series material.

The research design which was used in this study was pre-test post-test non-equivalent group design. This design was presented in the following table.

TABLE1. RESEARCH DESIGN

First experiment class (E_1)	*Pretest*	TPS combined with scientific approach	*Posttest*
	Scale		Scale
Second experiment class (E_2)	*Pretest*	SGD combined with scientific approach	*Posttest*
	Scale		Scale

Non-test and test instrument were used in this study. The test instrument consisted of pre-test and post-test, each of them consisted of four items. Test instruments were used to measure students' problem solving ability before and after the treatment. Non-test instrument consisted of a scale of self-confidence and observation sheets. The scales were given before and after treatment to measure students' self-confidence. Observation sheets were used to observe and record the implementation of the learning models.

The data obtained was analyzed by making a description of the study results and the description of the data which consisted of the early stage descriptions and the end stage descriptions. The early stages descriptions consisted of normality and homogeneity tests. Normality test was performed by using the Kolmogorov-Smirnov test with a significance level $\alpha = 0.0$. The homogeneity test was performed by using the Leven's with $\alpha = 0.05$. The end stage description was hypothesis test. The effectiveness of the learning model test was performed by using one sample t-test, and the comparison between two models test was performed using independent sample t test. The difference average test between two classes had been done to determine whether there are differences of average between them or not. This test has been done using independent sample t test before the comparison test.

The learning model would be effective in terms of problem solving if the value of the post-test students more than or equal to the limit of KKM which was 76. Effective learning model in terms of the student's self-confidence was when the final score of the student's self-confidence was more than 70. It was based on the criteria of student's self-confidence as in Table 2.

TABLE2. CRITERIA OF STUDENTS' SELF CONFIDENCE

Score interval	Category	Criteria
$X > \overline{X_i} + 1{,}8Sbi$	X > 85	Very Good
$\overline{X_i} + 0{,}6Sbi < X \le \overline{X_i} + 1{,}8Sbi$	70< X ≤ 85	Good
$\overline{X_i} - 0{,}6Sbi < X \le \overline{X_i} + 0{,}6Sbi$	55 < X≤ 70	Pretty Good
$\overline{X_i} - 1{,}8Sbi < X \le \overline{X_i} - 0{,}6Sbi$	40 < X ≤ 55	Less Well
$X < \overline{X_i} - 1{,}8Sbi$	X ≤ 40	Not Good

$\overline{X_i}$: Ideal Mean = $\frac{1}{2}$ (maximum ideal score + minimum ideal score)

Sbi : Ideal standard deviation = $\frac{1}{6}$ (maximum ideal score – minimum ideal score)

X : Total score

III. RESULT AND DISCUSSION

A. RESULT

1) Data of Problem Solving Ability Score

Pretest and posttests' mean score of the first experiment class were greater than the second class. However, posttests' standard deviation of the second experiment class was lower than the first one, but the pretests' standard deviation was greater than the first class. The complete data of problem solving ability score are shown in Table 3.

TABLE3. DATA OF PROBLEM SOLVING ABILITY SCORE

Description	Firs Class		Second Class	
	Pretest	***Posttest***	***Pretest***	***Posttest***
Mean	48.56	83.38	45.24	80.91
Maximum	69	93	65	93
Minimum	31	68	19	68
SD	9.066	5.146	9.692	4.895
Variance	82.193	26.486	93.939	23.96

2) Data of Self-Confidence's Score

The first and the second class experiment not only got pre-test and post-test but also got scale of self-confidence before and after they were treated. The result had been analyzed. The difference between before and after self-confidence's scale can be seen in table 4.

TABLE4. DATA OF SELF-CONFIDENCE

Description	Firs Class		Second Class	
	Before	**After**	**Before**	**After**
Mean	71.06	72.44	70.70	72.24
SD	5.898	4.850	6.502	5.995
Variance	34.784	23.527	42.280	35.939
Maximum	81	83	80	84
Minimum	60	61	51	62

Based on table 4, it was found that before treatments' Mean score of both classes was relative same. However, before treatments' standard deviation score of first class experiment was lower than the second one. After treatments' Mean score of both classes was also relative same and before treatments' standard deviation score of first class was also lower than the second class experiment.

3) Data of Problem Solving Ability

Solving problem in this study was conducted through four steps, they were understanding problem, planning to solve, problem solving, and rechecking the answer. The results of pre-test and post-test which was used to measure students' problem solving abilities were analyzed based on each steps as shown in table 5.

TABLE5. DATA OF PROBLEM SOLVING ABILITY

		Understanding	Planning	Problem solving	Recheck
E_1	*Pretest*	9.18	6.53	6.53	3.97
	Posttest	13.03	11.53	10.32	11.79
E_2	*Pretest*	9.24	6.21	5.21	3.76
	Posttest	12.09	11.18	10.48	11.58

Based on table 5, it was found that the ability of students from each step in solving the problem on the first experiment and the second experiment class has increased. The significant increase was seen in rechecking.

B. DISCUSSION

1) Description of Implementation

The learning process both classes were conducted using lesson plan which was created and appropriated to the learning model for each class. Overall, learning process in the both of experiment class were appropriate with lesson plan (RPP) which was created.

In TPS with scientific approach class, students do process think, pair, and share. During the think process, students do activities to observe, ask, and collect information that is facilitated using Student Activity Sheet (LKS). They individually think about their answer of the problem which is presented in LKS. After that, they were formed in heterogeneous pairs. The formation of this pair is based on students' achievement scores before the experiments. During the pairing process, students are discussing about the problems that they had tried to break beforehand. The teacher calls on individuals or pairs to share with the large group in front of the class. Based on the observation, it is known that TPS with scientific approach learning was 97 % conducted.

In SGD with scientific learning process, students are directly conditioned for flocking spontaneously and variously on each meeting. They discuss about the problem that is presented in the Student Activity Sheet (LKS). After the students had a discussion, the teacher calls one by one group to present the results of their discussion. Based on the observation, it is known that SGD with scientific approach learning was 96 % conducted.

2) Description of Data

a. Normality and Homogeneity Test

Pre-test, post-test and students' self-confidence after and before treatment on both the experimental class were normally distributed due to the p-value (sig) > $\alpha = 0.05$. Homogeneity test results of the pre-test, post-test and students' self-confidence after and before treatment of the both experiment class are homogeneous. It was because the significant > $\alpha = 0.05$.

b. TPS Learning Model Combined with Scientific Approach is Effective in Terms of Problem Solving

In the first experiment class, the treatment given was learning math using TPS with a scientific approach. The effectiveness of learning mathematics using TPS with a scientific approach in terms of mathematical problem solving abilities are based on a minimum predetermined completeness criteria, that is 76. Learning is said to be effective if the average value of problem-solving abilities posttest of first experimental class is equal to or more than 76. Based on analyze using one sample t-test, the significant value is 0.000. This value is less than 0.05. It means that H_0 was rejected. In brief, Think Pair Share (TPS) learning model combined with scientific approach was effective in terms of problem solving abilities. Think Pair Share (TPS) learning model combined with scientific approach helped the students to solve the problem individually before they discuss in pairs and present the discussion result. Thinking individually led the students to solve the problem with knowledge which they have learned before. During the thinking process, students do activities to observe, ask, and collect information. These three scientific processes help student to improve their ability in understanding and planning the solution from the problem. Scientific approach leads the students to solve problem using steps in scientific approach. During the pair process, student share their answer. They discuss about the best solution for the problem. This condition improves students' problem solving ability. The effectiveness of TPS learning was supported by Eny Sulistianingsih [3] in her research that TPS learning model is effective in term of problem solving ability.

c. TPS Learning Model Combined with Scientific Approach is Effective in Terms of Self-Confidence

The implementation of TPS with scientific approach was not only seen from the problem-solving ability but also self-confidence of students. The effectiveness of this learning model is based on the value of the category of confidence that is more than 70. Based on analyze using one sample t-test, the significant value is 0.006. This value is less than 0.05. It means that H_0 was rejected. In brief, Think Pair Share (TPS) learning model combined with scientific approach was effective in terms of self-confidence. TPS learning model combined with scientific approach leads students to solve the problem confidently. They solve the problem individually and then discuss it with their pair. TPS learning model also facilitates students to share their discussion result in front of the class. This process improves student's self-confidence. According to Robertson [6], TPS cooperative learning model had many advantages which benefit students. The advantages of questions are increasing belief in the ability of the student. As it has been explained earlier that the belief in the ability of selfis one aspect of students' self-confidence, therefore, the more increase of belief in the ability of student the more increase of students' self-confidence. The results of this study was also supported by Fadiah Khairina Earth [4], which states that TPS combined with problem-based learning will increase the confidence of students.

d. SGD Learning Model Combined with Scientific Approach is Effective in Terms of Problem Solving

In the second experiment class, the treatment given was learning math using SGD with a scientific approach. The effectiveness of learning mathematics using TPS with a scientific approach in terms of mathematical problem solving abilities are based on a minimum predetermined completeness criteria, that is 76. Learning is said to be effective if the average value of problem-solving abilities posttest of first experimental class was equal to or more than 76. Based on analyze using one sample t-test, the significant value is 0.000. This value was less than 0.05. It means that H_o was rejected. In brief, Spontaneous Group Discussion (SGD) learning model combined with scientific approach was effective in terms of problem solving abilities. SGD learning model combined with scientific approach manages students to discuss the problem in group. Each group consisted four or five members. Students followed the instructions in scientific approach to solve the problem. This situation is beneficial for students to practice solving problems by way of discussion. This is in line with the opinion of Tukiran Taniredja, et al. [20], that the benefits of the discussion group is train students to identify, solve problems and make decisions together. The results of this study was also supported by Ratih Damayanti [15], who states that SGD learning models increase students' activity of solving problem from 17.4 % to 73.91 %.

e. SGD Learning Model Combined with Scientific Approach is Effective in Terms of Self-Confidence

The implementation of SGD with scientific approach was not only seen from the problem-solving ability but also self-confidence of students. The effectiveness of this learning model is based on the value of the category of confidence that is more than 70. Based on analyze using one sample t-test, the significant value is 0.039. This value is less than 0.05. It means that H_0 was rejected. In brief, Spontaneous Group Discussion (SGD) learning model combined with scientific approach was effective in terms of self-confidence. SGD learning model combined with scientific approach facilitate students to share their idea in group. This process demands each student to take a responsibility to their groups' members. According to Lauster [19] responsibility is one of the aspects of self-confidence. Its means, if students' responsibility was improved, the self-confidence will increase. SGD learning model combined with scientific approach also facilitate students to share their result of the discussion in front of the class. This process will also improve students' self-confidence.

f. Result of Difference Average Test

Difference average test had been done to variables after and before treatment. The result of the test is shown in Table 6.

TABLE6. RESULT OF DIFFERENCE AVERAGE TEST BEFORE TREATMENT

Variable	**Data**	**Mean**	**Sig.**

Variable	Data	Mean	Sig.
Problem Solving	E_1	48.56	0.153
	E_2	45.24	
Self-Confidence	E_1	71.06	0.812
	E2	70.70	

Based on Table 6, it is known that the pre-test and the scale before treatment had significance value more than 0.05 so H_o was accepted. It means there was no difference average between first experiments class and second experiments class in term problem solving ability and self-confidence.

After that, the result of difference average test after treatment is shown in table 7.

TABLE7. RESULT OF DIFFERENCE AVERAGE TEST AFTER TREATMENT

Variable	Data	Mean	Sig.
Problem solving	E_1	83.38	0.048
	E_2	80.91	
Self-Confidence	E_1	72.44	0.882
	E_2	72.44	

Based on table 7, it is known that the post-test of problem solving had significance value 0.048. This value is less than 0.05 so that H_o was rejected. It means that the average between the both of class experiment in terms of problem solving ability was different. In other word, one of the two learning model is more effective than the other.

The result of self-confidences' scale after treatment, had significance value is 0.882. This value is more than 0.05 so H_o was accepted. It means that there was no difference between the first and the second experiment class in terms of students' self-confidence. In other word, TPS learning model combined with scientific approach is as effective as SGD learning model combined with scientific approach in term of self-confidence.

g. TPS Learning Model Combined with Scientific Approach is More Effective than SGD Learning Model Combined with Scientific Approach in Terms of Problem Solving

Based on analyze using independent sample t-test, the significant value is 0.048. This value is less than 0.05. It means that H_o was rejected. In other words TPS learning model combined with scientific approach is more effective than SGD learning model combined with scientific approach in term of problem solving ability.

TPS learning model combined with scientific approach helped students to solve the problem individually before they discuss in pairs, but in SGD learning model combined with scientific approach, students directly discuss the problem in group. It is the reason why students get better study's chance in TPS model. Members of group in TPS learning model combined with scientific approach were less than members of SGD learning model combined with scientific approach. That's why discussion in TPS learning model is more effective than discussion in SGD learning model. This study was in line with the opinion of TukiranTanureja [20] that the formation of the group will be effective if the number of members is not too much, so there will be no member who just boarded the name.

h. TPS Learning Model Combined with Scientific Approach is as Effective as SGD Learning Model Combined with Scientific Approach in Terms of Self-Confidence

Based on analyze using independent sample t-test, the significant value is 0.882. This value is greater than 0.05. It means that H_o was accepted. In other words TPS learning model combined with scientific approach is as effective as SGD learning model combined with scientific approach in term of self-confidence. TPS learning model combined with scientific approach leads student to solve the problem confidently. They solve the problem individually and then discuss it with their pair. SGD learning model combined with scientific approach leads student to solve the problem confidently with different members of the group in every different meeting. Both of learning model has sharing process that facilitates students to share their discussion result. This process will improve students' self-confidence.

IV. CONCLUSIONS AND RECOMENDATIONS

A. CONCLUSIONS

Based on the result, the researchers concluded:

1. Think Pair Share (TPS) learning model combined with scientific approach is effective in terms of problem solving.
2. Think Pair Share (TPS) learning model combined with scientific approach is effective in terms of self-confidence.
3. Spontaneous Group Discussion (SGD) learning model combined with scientific approach is effective in terms of problem solving.
4. Spontaneous Group Discussion (SGD) learning model combined with scientific approach is effective in terms of self-confidence.
5. Think Pair Share (TPS) learning model combined with scientific approach is more effective than Spontaneous Group Discussion (SGD) learning model combined with scientific approach in terms of problem solving.
6. Think Pair Share (TPS) learning model combined with scientific approach is as effective as Spontaneous Group Discussion (SGD) learning model combined with scientific approach in terms of self-confidence.

B. RECOMMENDATION

Based on the results of the study, it is recommended to use TPS learning model combined with scientific approach and SGD learning model combined with scientific approach to improve students' problem solving ability and self-confidence. However, to get better result in improving students' problem solving ability, using TPS model combined with scientific approach is more recommended.

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The Characteristics of Teachers' Contingent Dominant Scaffolding in Teaching and Learning Mathematics

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***Abstract*—** The purpose of this study is to investigate the characteristics of teachers' scaffolding in teaching and learning mathematics carried out by two teachers showing contingent dominant interaction. The characteristics were obtained by examining the conversations fragments between teachers and students during the provision of scaffolding. The fragments of conversation which were recorded by a video recorder were then transcribed for data analysis. The result shows that although the two teachers had the same contingent dominant interaction, they expressed different approach to contingencies characteristics in their scaffolding activities consisting of analytic and intuitive. In addition, the teacher using analitic contingent dominant interaction is likely to provide scaffolding more strictly and deeply in providing learning assistance to students compared to that of the teacher using intuitive contingent dominant interaction.

Keywords: *analytic, characteristics, contingent dominant, intuitive, scaffolding*

I. INTRODUCTION

Scaffolding has been in great demand in the field of mathematics education of recent studies [1], [2], [3]. The study of scaffolding strategies in geometry found that the involving student participation is the scaffolding strategy that frequently used by teachers [1]. The study of scaffolding used by two mathematics teachers with different teaching experiences found that scaffolding conversations appeared to have a positive impact on the learning and scaffolding using manipulative tool frequently appeared to have a positive feelings about using materials [2]. Furthermore, [3] tried to apply the idea [4] which introduced the scaffolding in mathematics as a "tool-for-result" and as a "tool-and-result" to distinguish the two dialogues of teachers-students in elementary school. However, all those studies have not yet examined in detail regarding the provision of scaffolding by teachers during dialogue. Therefore, the contingency of scaffolding as a match between what the teachers and students understood as a dialogue [5], should be studied further in the integrated concept in teaching and learnin [6].

Scaffolding is one of the characteristics of effective teacher-initiated teacher-student dialogue on the learning of mathematics. It deals with the ways in which teachers use dialogue to scaffold students' understanding. According to [7], few of the studies provide evidence that such characteristics actually led to promotion of students' conceptual understanding of mathematics. Actually, dialogues between teachers and students when scaffolding can eveal the extent to which teachers approach to students' understanding. So, through dialogues, the teachers' characteristics associated with scaffolding given can be known.

Patterns of the contingent teaching when scaffolding in social science, i.e. contingent and non-contingent have been introduced in [5]. However, the characteristic of mathematical content that is abstract and requires deductive thinking implies different approach to facilitating student learning than approach to learning social sciences. Refer to [5], the study on contingency patterns of interaction in the context of mathematics teaching and learning when teachers provide scaffolding to students showed three patterns of interactions, namely: the contingent dominant, the non-contingent dominant, and the pseudo-contingent [8]. Of course, effective teachers would want to have a contingent dominant interaction in the teaching and learning. So, the study of the characteristics of teachers' contingent dominant interaction when scaffolding is more interesting than the study of characteristics of teachers' non-contingent dominant or pseudo-contingent interaction. However, the study about it has not been revealed by researchers yet. Therefore, the research is needed to investigate the characteristics of teachers' caffolding in learning and teaching mathematics carried out by teachers showing contingent dominant interaction. The results of this study are indispensable for future research in uncovering the thinking processes of the contingent dominant teachers when scaffolding in teaching and learning mathematics.

II. THEORETICAL FRAMEWORK

A. *Effective Mathematics Teacher*

Effective teachers will be able to understand and apply various strategies to help the students improve the learning outcomes [9]. Generally, mathematics teachers help students by means of dialogue either as individuals or groups related problem or a math assignment. The dialogue can be initiated by the student or the teacher. Dialogue can occur when a student asked about mathematical objects which are being facilitated by teachers (concepts, principles, or procedures) that have not understood by students yet. Dialogue can also occur because teacher read the conditions of the students psychologically who are deadlocked in their duties. However, based on observations of the researchers, the dialogue often occurs when teachers allow students asking while doing exercises. Assistance provided by the teacher when this dialogue is meant as scaffolding in this study.

Why dialogue? According to [6], the dialogue is one key to the success of scaffolding. Through dialogue, there will be a balance of what was presented by teachers with the students' understanding. Added by [3] that knowing mathematics is helping students through dialoging and doing. Therefore, scaffolding and dialogue in learning mathematics are closely linked to one another. Both of these have the same origin sourced from psychology education as proposed by [10]. Therefore, an effective mathematics teaching and learning must necessarily dialogue.

B. Scaffolding in Learning Mathematics

Scaffolding is part of the learning strategies that require the teacher's role to facilitate student learning [11]. Through scaffolding, students are expected to have independence in learning the material that is facilitated by teachers [12]. At the end of the scaffolding, the teacher's responsibility has been left entirely to the students so that students are able to perform their duties independently [5].

Practically, the provision of scaffolding on math learning can be different from one teacher to another According to [13], there are teachers who are able to provide scaffolding in a certain way, but the teacher was unable to give any other way. For teachers who have the knowledge, skills and experience to facilitate lesson well, then they will be able to guide students towards in deep understanding. Of course, it differs from teachers who have less knowledge, then he will have a hard time helping the students. Therefore, the provision of scaffolding is very dependent on the knowledge, skills, and experience of teachers in providing scaffolding [14].

C. The Contingency of Scaffolding in Teaching and Learning Mathematics

Contingency is a requirement for scaffolding [5]. If a teacher gives the scaffolding to students contingently then the scaffolding should be gradually reduced so that the teacher's responsibility should really have been transferred to the students. Assistance given by the teacher to the student should be appropriate to the level of students’ understanding. In other words, when scaffolding, teacher need to show the interaction that adjusts assistance given to the condition of the students.

Knowing the contingency of teachers’ scaffolding means that analysing of the fit between teachers’ help and the students' understanding. It can be done by teacher using D (Diagnostic strategies), I (Intervention strategies), and C (Checking of diagnosis). In analysing the diagnostic strategies, teachers focus on: (a) the posing of diagnostic questions and (b) the reading of student work, to discover the level of the student’s ability to perform without assistance. Checking of the diagnosis means verifying whether teachers have understood the students correctly or not. Checking of diagnosis will give teachers more information on understanding and students' strengths. In the intervention strategy is simply defined as a strategy used to support the student by giving the feedback, hints, instructing, explaining, modelling, and questioning (assisting) [5]. Refer to [5], the interaction learning math teachers are naturally contingent dominant still hard going [8]. Observations [8] to the math teachers in Malang, only 10% of teachers demonstrated contingent diminant learning interactions. These conditions would have to continue to be sharpened as consideration for teachers or decision-makers to improve the process of teachers’ scaffolding in the classroom. Therefore, efforts to investigate the characteristics of teachers’ contingent dominant scaffolding needs to be done to enrich the science, especially how teachers provide scaffolding to students contingently.

III. METHOD

Researchers surveyed 25 mathematics teachers in Malang since 2015 and found two contingent dominant mathematics teachers in scaffolding, i.e. AD, and DW. AD (male mathematics teacher) had a master degree and four years of teaching experience in Senior High School. DW (female mathematics teacher) had a bachelor degree and four years of teaching experience in Madrasah Aliyah. Both teachers taught trigonometry subjects for the 10^{th} grade.

The research data in the form of a dialogue transcription teachers and students when scaffolding obtained from video of learning. The fragments of conversation which were recorded by a video recorder were then transcribed for data analysis. Analysis of data using qualitative method. For the purposes of data analysis, researchers encode any statements or questions in the dialogue with the code fragment aforementioned, i.e. D, C, or I, refers to Appendix F in [15]. At the same time, researchers play the video to see teachers' scaffolding according to the context of the problem. Because of many fragments, researchers only focused on analyzing the most representative fragments corresponding context of the problem and occurs naturally in the material scope of trigonometry.

IV. RESULTS

General information about the learning interaction fragments by two contingent dominant mathematics teachers in this research is presented in Table 1.

TABEL 1. GENERAL INFORMATION ABOUT TEACHERS' CONTINGENT DOMINANT SCAFFOLDING IN TEACHING AND LEARNING MATHEMATICS

Teacher	Problems	Scaffolding Contingency Strategies Used by Teachers			Characteristics of Teachers' Scaffolding
		Number of Diagnostic Strategy (D)	*Number of Intervention Strategy (I)*	*Number of Checking of Diagnosis Strategy (C)*	
DW	Determine sine 270^0	4(18,18%)	13(59,09%)	5(22,73%)	- Performing diagnostics strategy by questioning - Implementing intervention strategy dominantly - Doing checking of analysis strategy in less rigorous and less deep - Encouraging students toward procedural understanding - Often implementing the strategies by requesting "go on", less asked for justification, and failed to give feedback on the students' answers - Emphasizing the dialogue to encourage students to focus on getting the answers than thinking processes - Using "tool-for-result" approach dominantly - The conclusion: Teacher uses an intuitive approach
AD	Determine sin $(90\text{-}\theta)^0$, known sin $\theta = a$, $a \neq 0^0$.	8(24,24%)	9(27,27%)	16(48,48%)	- Performing diagnostics strategy by reading the student's work and questioning - Implementing checking of analysis strategy dominantly - Conducting checking of analysis stricly and deeply - Encouraging students toward a conceptual understanding - Often implementing the strategy by using the question "why", asking for justification, and providing feedback by commenting on the students' answers - Emphasizing the dialogue that encourages students to get answers thoughtfully - Using "tool-and-result" approach dominantly - The conclusion: Teacher uses an analytic approach

A. DW's Description of Teaching Interaction

The following fragment is DW dialogue with students in developing contingency learning interactions when doing trigonometry exercises, i.e. when students asked for the value of sine 270^0.

Fragment 1

Line 1: S: Here Mis ...do I take 90^0 or zero? If I mean that in 270^0 ...looking for sine 270^0... is it minus 1 ... or should I remain the same as that of what I take, that is sine 90^0, so you know ...?
Line 2: T: What do you mean with how to take the 90^0? [D]
Line 3: S: I mean that will I take sine 90^0, so you know Mis?
Line 4: T: yes ...
Line 5: S: Why don't we take 0^0 Mis ... but ...
Line 6: T: You make sure ...that 270^0 that you want...what quadrant will you take! [I, Instructing]

Line 7: S: It is the third or the fourth, Mis ...
Line 8: T:The third or the fourth ... certainly you make sure ....whether to take the third or the fourth quadrant? [I, Questioning]
Line 9: S: Yes it is ...Mis ... [the student is getting confused with a slight laugh]
Line 10: T: Don't be confused ... chose it! ... [I, Instructing]
Line 11: S: Oh ...
Line 12: T: Choose one! ... [I, Instructing]
Line 13: S: [pause] ... if in the third quadrant...it becomes 90^0...[student thinks aloud]
Line 14: T: e e ...
Line 15: S: If I take the fourth quadrant...it becomes 0^0... [student thinks aloud]
Line 16: T: e e ... ok come frward, which one... is it right? [D]
Line 17: S: Yes
Line 18: T: Now choose one ... so ... let's say .. if the third quadrant is chosen .. do we use the angle? [I, Feedback, Hints]
Line 19: S: 90^0 ...
Line 20: T: yes already ... we use the angle of 90^0 ...do not use the zero one .. [I, instructing]
Line 21: S: [students paused]
Line 22: T: If we take the zero ... do we..use 270^0 minus zero, if so, is it you mean? [D]
Line 23: S: Not ..I mean ... right ... like this anyway Mis ... [students tried to explain the meaning of the question with drawing] It's 270^0 ...
Line 24: T: em
Line 25: S: if we are right with this way ... 90^0 ...
Line 26: T: em em
Line 27: S: Mis, from this 90^0 ... but if we follow the portrait...we have 0^0...here.
Line 28: T: Please try to count it... calculate it ..compare it ... let's see...what quadrant do we take?... [I, Questioning]
Line 29: S: The third
Line 30: T: The third quadrant... try ... how? [C, Instructing]
Line 31: S: This is sine...it means ...minus 1, right? [student explains about the third quadrant]
Line 32: T: em ..
Line 33: S: If here is cosine [student shows four quadrants,] meant that ... zero
Line 34: T: Cosine ... how would it be cosine?. [C]
Line 35: S: Sine is zero
Line 36: T: How does sine become zero? [D]
Line 37: S: Zero
Line 38: T: zero ..please go on...try to write it ...yes write it... I'm confused too ... write in two ways ... how does the first way...and how does the second way...which way to have the correct answer? ... [I, Hints]
Line 39: S: [students write the answers on a blank paper, sin 270^0= -sin 90^0)]
Line 40: T: [Teachers pay attention to the students' work] Please write how you found $90^{0...}$The way can be displayed... please! [C, Questioning (assisting)]
Line 41: S: [students delete what she wrote and write the new answer]
Line 42: T: em em ... [teachers pay attention to the students' work] Try the second way ... [C, Questioning (assisting)]
Line 43: S: [students write the second way] oh yes yes Mis ... [Students stop his work because they feel satisfied to the answer]
Line 44: T: Try to continue ... to convince the answer .. [I]
Line 45: S: [students continue completing the work]
Line 46: T: [Teachers pay attention to the work of students] sine is minus 90 ... keep anyway? No such effect ...
Line 47: S: Yes yes yes
Line 48: T: If you want to exclude from the limit ... earlier or later ... no problem ... but you should be consistent ... seen from the characteristics..what is potitive...what is...[I, Instructing]
Line 49: S: Negative
Line 50: T: It is the same, isn't it? [C]
Line 51: S: Yes yes yes ...
Line 52: T: Well, this is minus sine 90^0[Teacher reminded to use minus sign (-) before sine 90^0] Is it the same? Take one only ... [The teacher left the student] [I, Hints]

Based on the fragment above, DW applies diagnostic strategies (lines 2, 16, 22, 36), intervention strategies (lines 6,8, 10, 12, 18, 20, 28, 35, 37, 39, 44, 48, and 52), and checking strategy analysis (lines 30, 34, 40, 42, and 50) when the scaffolding. However, DW uses the intervention strategy dominantly. DW is more focused on how to find the results. DW uses intuitive approach to the provision of scaffolding. In view of this, a mathematical intuition is not associated with formal reasoning. Namely, DW presents a mathematical problem in how to find the answers immediately, without need to have justification or formal analysis. The researchers mentioned DW as classical intuitionist [16]. Even if there is to discover students' knowledge as a support, such as the question; "Why?", "How do you know that?", are still rare. DW often does the interactions like that. This conformed to the findings [17] that teachers rarely explored right naturalness of students problem.

DW rarely conduct an investigation into what is being done by students. In other words, the assistance provided by DW less deep to explore the knowledge of students. DW often use intervention strategies by giving hints (clues) or feedback. In fact, DW reminded students to make the conclusion that is being done. The contingent dominant approach of the provision of scaffolding that impressed DW done quickly, not long, less to enable children to think deeply, and spontaneously. DW tends to encourage students toward procedural understanding. DW rarely ask the question "why", asked for justification, and comment on the students' answers. DW emphasizes dialogue to encourage students for finding the answers rather than thinking. Therefore, considering the characteristics scaffolding done by DW, the researchers mention that DW as a teacher who has intuitive contingent dominant characteristis.

B. AD's Description of Teaching Interaction

Here is a fragment of scaffolding when AD taught trigonometry in determining sin (90 - θ), known sin θ = a, a $\neq$ 0.

Fragment 2

Line 1: S: How about the second number, Sir?
Line 2: T: Second number ...have you completed it? [D]
Line 3: S: Not yet
Row 4: T: [The teacher read the student's work while pointing out] If this.. is simplified, so what will happen?[D, C, Questioning]
Line 5: S: What?
Line 6: T: It's, you know ... [Teacher sees the student writing sin (90-q)] [I, Hints]
Row 7: S: Ninety ... [Student thinks hard]
Row 8: T: Sine of ninety degrees min theta... if is simplified... [the teacher pointed to the 90-θ] [C, Feedback]
Line 9: S: Sine theta...
Line 10: T: Well ... It's ... 90^0, right? [Pointing to article 90^0-θ] [D]
Line 11: S: Yes
Line 12: T: What's kind of axis...this? [D]
Line 13: S: The Y-axis
Line 14: T: If there is a reference axis of Y ... Y ... [C, Questioning]
Line 15: S: Reversed to cosine Y
Line 16: T: Yes ... the result is ... [C, Questioning]
Line 17: S: Cos θ
Line 18: T: Yes already [Feedback]
Line 19: S: [keep silent]
Line 20: T: What is known? [D]
Line 21: S: Sine θ
Line 22: T: What will you find? [D]
Line 23: S: Cosine θ
Line 24: T: How can it be? [C, Questioning]
Line 25: S: Reversed, right?
Line 26: T: Lho...why is it reversed?... sinus is known ... keep looking cosine θ .. θ, How do you find it? [C, Feedback]
Line 27: S: [pause, confused]
Line 28: T: [Teacher directly asked the question] if sine θ is known... what is the comparison of sine? [C, Feedback, Questioning]
Line 29: S: opposite ...hypotenuse ... oh ..looking ...adjacent...
Line 30: T: Lho .... it means that what should be drawn?. [I, Questioning]
Line 31: S: Drawing a triangle
Line 32: T: What triangle? [D]
Line 33: S: Right triangle
Line 34: T: Yes ... draw it, try! [I, Instruction]
Line 35: S: Sinus ..opposite ...hypotenuse ...
Line 36: T: Set the first angle ... [The teacher immediately cut the student's statement] [I, Hints]
Line 37: S: [students draw a triangle while thinking aloud]
Line 38: T: No ... only its angle ... [I]
Line 38a: S: [Doing]
Line 39: T: Yes ...
Line 40: S: ..opposite ..hypotenuse...a, sir?
Line 41: T: a ... the "a" is meant...? [C, Questioning]
Line 41: S: [students is thinking] em?
Line 42: T: a.. means ... the same as ? [C, Questioning]
Line 43: S: 1
Line 44: T: Yes ... the same as opposite over ... [C]
Line 45: S: Hypotenuse...
Line 46: T: Yes..how is that?. [I, Questioning]
Line 47: S: 1
Line 48: T: Why is 1? [C, Questioning]
Line 49: S: a is divided by one ... a
Line 50: T: yes .... It means… is it the line? [The teacher showed a right angle of triangle] [C]

Line 51: S: 1... a
Line 52: T: Lho, why? .. [Teacher asked for the reasons of getting 1 surprisingly] [C]
Line 53: S: Oh ... 1 minus a ...
Line 54: T: Lho... why 1 minus a? [Teacher asked for the reasons of saying 1 minus a surprisingly][C]
Line 55: S: 1 min ... a square ...
Line 56: T: go on ... [teachers justify] [I]
Line 57: S: It is rooted ...
Line 58: T: Okay, rooted ...then... [Feedback]
Line 59: S: How is this? [Student try to root ...while thinking aloud] one minus ....
Line 60: T: It cannot, ... can you? [D]
Line 61: S; 1 min a squared ...Sir?
Line 62: T: Lho ... it's worth ... it is still ... [C]
Line 63: S: But ... that's not the point ... like this, you know ... [students write the sgns of under root of 1- a squared]
Line 64: T: Yes ... keep being asked about? [D]
Line 65: S: Cosine
Line 67: T: Write, please! [I, Instructining]]
Line 68: S: Cos b
Line 69: T: Lho ... cosine theta [justifying the way the students read Cos b of which it should be theta] [I]
Line 70: S: opposite...hypotenuse [students write] 1 per root ....
Line 71: T: Lho, cosine theta you know ... [I]
Line 72: S: Oh ya ..ya ..it was reversed ...reverssed ... [students failed to determine the ratio of 1 to the root of $(1 – a^2)$*]... yes ...this is the answer! [while he saw no option not to answer the question] Oh, ... oh yes yes... [student reveals satisfaction in her work]*
Line 73: T: [Teacher left the student]

Based on the Fragment 2, AD starts providing the scaffolding using diagnostic strategy (D) by questioning using wh-question or yes/no question (line 2, 4), reading the students work, and continuing to use checking strategy directly (line 4). In general, AD implementing three strategies scaffolding almost evenly, although slightly more dominant implementing checking strategy (lines 4, 8, 14, 16, 23, 25, 27, 29, 40, 42, 44, 48, 50, 52, 54, and 62). It was demonstrated that AD provides scaffolding to students strictly, which began with an intervention in the form of a question that asks every step of the student after performing diagnostics. Almost every step of workmanship students are faced with the question "why or *lho*", as a way to reinforce the problem or checking (*Lho* is a special word that expressed surprise or shocked in the Javanesse). AD is more dominant inquire initial concepts and skills (procedures) of that students did and students will do. AD does not let students write just the answer without questioning as student to teacher accountability. In other words, AD strictly controlling every step in the order execution strategies help students apply D (Lines 2, 16, 19, 21, 31, 36, 60, 64), I, C or D, C, and I strategies.

AD is very often generate the interactions such as Fragment 2. As a whole interaction, AD almost equal implements the three strategies (D, C and I) in providing scaffolding (can be seen in Table 1). Although the strategy of checking of doagnosis (C) is more dominant than the other two strategies, but AD’s intervention strategies do not directive in the sense of giving out the answers but rather intervence students to think about issues being worked student. AD tends to do well in solving the problem. AD tried to breakdown the problem into small parts of pieces of students work. A small section was more probing students' prior knowledge about the fact that demands memorizing. This is in accordance with the said [18] that the analytic resolve the problem based on facts and logic rather than emotion. Based on this description, the researchers mention that AD as a teacher who has analytic contingent dominant characteristic.

V. DISCUSSION

Learning is a process of building relationships between teachers and students in mathematics in order to construct meaning both individually and collectively [19]. This research has shown the empirical facts about the characteristics of teachers’ contingent dominant scaffolding in teaching and learning mathematics in order to construct mathematical meaning, specially in trigonometry. Although this study did not generalize the findings, but the empirical evidence has shown that the contingency provision of scaffolding can be reached by teachers through two approaches, i.e. intuitive and analytic. Empirical evidence also showed that the interaction of contingent dominant learning mathematics teacher are possible on the background of different types of schools, i.e. a public high school and religious schools. However, the ability of teachers about the material presented is a factors to consider and have not been studied in this research.

As shown in Fragment 2, AD used a strategy that breakdown the student understanding when scaffolding. When students asked about the concept or procedure that is not understood, AD does not only help students to resolve the question asked but AD also expands these problems by exploring related concepts of the problem. In other words, AD tends to implement the checking and intervention strategy through questioning with the aim of "assisting". Each student responses when scaffolding followed by excavation deeply about what is known, and what is understood, by students. Furthermore, AD uses information from the student's response to resolve the problem presented students. In the dialogue, AD does not believe the student's response before the students were able to answer every question asked by AD in connection with concepts or facts. It could be argued that the scaffolding by AD is conceptual. It was conscious and was impressed slow. Considering such a process, the authors state that AD uses an analytic approach in his scaffolding.

Contrary to AD, as shown in Fragment 1, DW dominantly use intervention strategy with focus on results being achieved, not focus on the process. When students asked about the concept or procedure that they have not understood yet, DW focuses on helping student to the question without extending the problem in the question or without digging the concepts involved deeply. In other words, scaffolding of DW tends to be procedural. This happens spontaneously and quickly. Considering such the process when scaffolding, the authors states that DW uses an intuitive approach.

Actually, the two teachers in this study have shown a good approach in the provision of scaffolding because both have shown the contingent interaction. However, the opportunity to engage students in learning mathematics need attention by the teacher. Moreover, learning is not about receiving information but more than that, learning is about building relationships to construct a strict mathematical meaning [19]. Therefore, what is done by the AD above is actually very consistent with the concept of learning desired in the classroom. As stated by [19] that the class should be a place where teachers and students engage in learning activities that are rigorous mathematics. Opportunity should exist in a class that allows the teacher relates to students. Added by [19] that as many teachers ask questions to the students and the question was not just recall, it gives students the opportunity to express their ideas and verbal activity can develop students' understanding.

When associated with a dual theory of S1 and S2 according to [20], both teachers demonstrated in different ways. AD using S2, as though the help seems slowly, but he was full of awareness in helping children to understand, not only results. According to the view [4], AD approach known as "scaffolding as tool and result". This differs from the DW help children tends to get results only. According to the view [4], DW approach known as "scaffolding as a tool for result". The differences of interaction of both teachers can be influenced by several factors, e.g. the teachers' experiences, type of school, and learning approach that transactions are carried out [14]. Both the teachers in the study are different educational backgrounds. AD is a master educational background, while DW is a scholar. Of course, the experience of this background needs to be considered in establishing contingency, especially the two teachers belong to a relatively young age and have a high motivation. However, the interesting in this study is that even teachers with less than five years experiences, both AD and DW are able to show learning the contingent dominant interaction patterns naturally.

All the three strategies built by the teachers in scaffolding need guiding, including language problems or questioning skills. As in [21] that if learning occurs in social interaction, language or speech is an important tool for communicating and guiding learning. Through language, a student can express his understanding, giving reasons, posing a problem, and learning. Through language, teachers and students are able to build shared knowledge in interaction, i.e. they are thinking. Therefore, teachers need to have the skills of questioning. According to [22], based on the level questioning can occur: 1) at a low level, asking the skills, and 2) a high level, that asks or encourages thinking like asking to explain the process of what is found.

Of course, this study has some limitations. First, this study only just looked at two new teachers' contingent dominant interactions when scaffolding. Second, the issues raised in this study only in trigonometry that is in similar problems. Therefore, future research can be conduct by lifting the same exact problem and more than two teachers (if possible). But it will not be easy to do because to find the contingent dominant teacher in mathematical scaffolding is a tiring job.

VI. CONCLUSION

This research found the characteristics of teachers' scaffolding in teaching and learning mathematics carried out by two teachers showing contingent dominant interaction, namely: intuitive and analytic. The teacher whose intuitive contingent dominant interaction tends to use the approach that explore the informal knowledge or the intuitive knowledge of students to develop procedural knowledge. This aproach can be reached by starting the process of scaffolding through an easy problem for students. From here, teachers can develop students' understanding. Via this approach, the teacher has a quickly and less digging the student understanding. Some characteristics of this approach of teachers are: faster, less strict, less careful, spontaneous, very considering limit of time, and using scaffolding as "tool-for-result".

Teachers whose analytic contingent dominant interaction is likely provide the scaffolding approach by exploring formal and procedural knowledge of students to develop conceptual knowledge. Teacher can reached this approach with the help of probing students understanding. From here, the teacher can develop students' understanding and a mindset of students to thrive in solving the next problem. Some of the inherent nature of this kind of teacher are: tight, rigor, meticulous, long, carefully, seriously, no matter of limit of the time of teaching, unpretentious, and using scaffolding as a "tool-and-result". So, teachers using analytic contingent dominant interaction is likely to provide scaffolding more strictly and deeply in providing learning assistance to students compared to that of the teacher using intuitive contingent dominant interaction.

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ME – 08

Effectiveness Problem Based Learning And Scientific Approach To Improve Higher Order Thinking Skills

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Abstract— This article aims to describe theoretically the effectiveness of problem based learning and scientific approach to improve higher order thinking skills. Problem-based learning and scientific approach is the same approach - the same student-centered, students not only gain knowledge directly, but also students should build their own knowledge. Problem-based learning is an approach centered learning students the basic problem is presented in the form of real problems, charming, authentic, ill - structured and a variety of variations to finish with the advantages of developing the problem solving ability of students, develop higher order thinking and scientific skills, integrating theory and practice, and motivate them, develop time management and data collection. While scientific is an approach to learning students actively integrating students in the process of thinking and the use of methods that are scientifically proven by conducting experiments to test the hypothesis, with the advantages of encouraging and inspiring students to think critically, to inspire learners are able to think hypothetically see the different, similarities and link to one another on the substance of learning materials. Higher order thinking skills is a process of thinking skills in depth and widespread that involves information processing in critical and creative in facing and resolving problems that are complex include critical and creative thinking skills. Syntax of PBL used to increase HOTS include (1) supply issues, (2) strategic planning, (3) investigation, (4) presented the results and (5) evaluating, whereas syntax of scientific approach used include: (1) observing, (2) questioning, (3) associating, (4) reasoning and communicating.

Keywords: *problem-based learning approach, scientific approach, higher order thinking skills*

I. INTRODUCTION

The development of science and technology in the century - 21 is rapidly have led to competition in many areas of life , including education. Human resources will be generated from the high-grade quality education, to train students' thinking skills and produce high-quality output that will require higher thought processes, skill in question is a high-level thinking skills are often called Higher order thinking skills (HOTS). Higher order thinking skills is a process of thinking skills in depth and widespread that involve processing the information critically and creatively in facing and resolving problems that are complex include critical and creative thinking skills [1], [2], [3], [4], [5], [6], [7]. Therefore, the government did not remain silent to always make changes such as holding facilities and infrastructures then revise the current curriculum of the Education Unit Level Competence (SBC) was revised to Curriculum 2013. The curriculum is aimed at improving the quality of human resources and enhance the nation's competitiveness, and along with the development of science, technology and art. The curriculum is expected to produce human resources productive, creative, innovative and affective competencies through strengthening of attitudes, knowledge and skills [8]. But the fact that the government declared curriculum has not been fully realized with the expected, according to [9] there are four obstacles teachers in implementing the curriculum in 2013 one difficulty to enable students in the classroom.

In the learning process needed both models, strategies, and learning approaches that can optimize the learning activities of students in the training of high-level thinking skills. One of them problem-based learning (PBL) is a learning approach centered on the students the basic problem is presented in the form of real problems (real word), charming, authentic, unstructured (ill - structured) and a wide variety to complete [10], [11], [12]. PBL theoretically could increase higher order thinking skills [13], [14]. Learning problem based learning is conducted in stages presents a problem, strategic planning, investigation, presented the results and evaluate. In addition leraning problem based learning, curriculum 2013 also recommends the scientific approach. Approach scientific an approach to student learning actively integrating students in the process of thinking and the use of methods that are scientifically proven by conducting experiments to test the hypothesis, with the advantages of encouraging and inspiring students to think critically, to inspire learners are able to think hypothetically in seeing the differences, similarities and link to one another on the substance of the study [15], [16] [17], [18].

Scientific taught us to think why something is happening ?, and what causes something to happen? then what about the solution of the problem that has occurred? [15]. From here students are encouraged to think radically and critically. The scientific approach is conducted in stages: observe, ask, gather information, reason and communicate.

Based on two approaches that have been mentioned are problem-based learning and scientific approach theoretically they can increase students' higher order thinking skills are critical and creative, so it is important to compare the two, which is more effective when used in learning, especially learning math.

II. Discussion

A. Higher Order Thinking Skills

High-level thinking skills necessary to be applied to the students, because it will train students to think critically, creatively and skeptical of the problems encountered in the century - 21's. [19] states: "The definition of essential thinking skills: thinking is Generally assumed to be a cognitive process, a mental act by the which knowledge is acqured". This is in accordance with [20] on Graduates Competency Standards for Primary and Secondary Education stated qualifications in the ability of junior-dimensional skills have the ability to think and act of effective and creative in the realm of the abstract and the concrete in accordance with the learned in school and learning resources similar.

Thinking is a mental activity that a person experiences when faced with a problem or situation that must be resolved. [21] revealed some sense thinking: (1) thinking is a process that involves surgery - mental operations such as induction, deduction, clarification and reasoning, (2) thinking is a process of representation symbolically (through language) various objects and events real use it to find a symbolic representation of the principle - essential principle. (3) thinking is the ability to analyze, mengkkritik and make generalizations. Furthermore, [22] declared four levels of thinking (level of thinking) as follows; (1) Recall (Given) at this stage a person requires the ability to review the event / experience before ever done or ever learned. (2) Basic (Basic) ie prior knowledge as a foundation for higher capability of basic capabilities such as addition, subtraction, multiplication and division. (3) Critical thinking (critical thinking) is the ability to evaluate and analyze more complex. (4) Creative thinking (creative thinking) is able to create ideas / new ideas that had not been done.

According to [1] Higher Order Thinking skills are categorized into 3 parts: "definitions that I find into three categories: (1) Reviews those that define higher order thinking in terms of the transfer, (2) Reviews those that define it in terms of critical notes thinking, and (3) Reviews those that define it in terms of problem solving ". In this case the definition of higher order thinking skills are categorized into three: (1) as a form of transfer of learning outcomes (2) as a form of critical thinking and (3) as a problem-solving process. While [6] expressed a high level thinking consists of understanding (comprehension), problem solving (problem solving), critical thinking (critical thinking) and creative thinking (creative thinking). [2] states HOTS characteristics as follows: "The characteristics of higher order thinking skills: higher order thinking skills encompass both critical thinking and creative thinking", there are two underlying characteristics HOTS is critical and creative thinking.

Characteristics HOST expressed Resnick (1987: 3): "Higher order thinking skills is non algoritmic, complex, Often yield multiple solutions, Involved nuanced judgment, involves aplications of multiple criteria, Often involves uncertainty, involves self-regulation of the thinking process, involves imposing meaning, effortful ". This means HOTS has the following characteristics: unstructured step - step process, is complex, many of the solutions, involving variations in decision-making and interpretation, many criteria and more effort in doing it. [2] states that: "Higher order thinking skills Contribute to academy achievement". HOTS can be said to support the academic achievement of students.

Furthermore, [3] states: "Higher order thinking Occurs when a person takes new information and information stored in memory and interrelates and or rearranges and extends this information to Achieve a purpose or find possible answers in perplexing situations". So think high tigkat can occur when someone takes and stores the information in his brain and process well and extend that knowledge to reach the goal and immediately find the appropriate answer. According to [23] refers to the cognitive realm of Bloom's taxonomy consists of six levels: 1) Knowledge (knowledge): the ability to remember the material they have learned from the experience of learning. 2) Understanding (compprehension): the ability to grasp the subject matter can be words, numbers, explaining causation. 3) Applications (application): the ability to use the subject matter that has been learned through the experience of learning to the circumstances and conditions that are more concrete. 4) Analysis (analysis): ability to break down the material into parts sehigga organizational structure of matter can dimegerti, 5) Evaluation (evaluation): the ability to take a decision to give an assessment or value judgment on a subject matter in accordance with the objectives. 6) Create (create) is able to make a product / idea either the formulation or form tools.

Level think high-level visits of the cognitive domain Bloom's taxonomy of time at the level of analysis, synthesis and evaluation, meaning the new taxonomy HOTS this to the level of creation. Associated with the revised Bloom taxonomy, is the higher - order thinking is the ability to think from analyzing aspects to creating. The following phases of Higher Order Thinking skills according to [24]:

1) Analysing: involves breaking material into its constituent parts and Determining how the parts are related to one another and to an overall structure. This means that learners fragmenting learned information into its parts in order to obtain information that he can be understood as well as possible. The activities can be grouped Analysing: differentiating, Organising and attributing.
2) Evaluating is defined as making judgments based on criteria and standars. Learners make decisions based upon deep reflection, critique, and assessment. The activities can be grouped evaluating: Checking and critiquin.
3) Creating have students make a new product by mentally reorganizing some elements or parts into a pattern or structure not present before Cleary. Learners mengkreasi new ideas by utilizing previously learned information. Thinking activities that can be categorized aspects of creating: Generating, Planning and Producing.

Critical thinking according to [25]: "critical thinking is the ability to a make rational decisions about what to do or what to believe". that argument is expected for students in a lesson can always respond to critical issues. In addition [26] states that: "critical thinking is a deep thinking process, the which helps us to understand what may be right or wrong. It is analyzing our past experiences and it helps us to resolve situations ". Then [27] states that: "critical thinking is reasonable reflective thinking focused on Deciding what to believe or do". This means that critical thinking is reasonable and reflective thinking focused on determining pa trust and what to do. Creative thinking is not separated with activities - activities that lead to a person's creativity, in the opinion [28] states that: "creativity is pusposeful and involves effort to the make something better, more meaningful, or more beautiful. Meaning: creativity is a goal that involves an attempt to create a job, create a better, more meaningful or more beautiful. On the other hand think creatively defined by [29] stated that: "creativity is the capacity to create, to produce new things". This means that creativity is the ability to create, to produce things - new things. Trying to think creatively is not easy, a creative thinking must dare to fail and try to continue to find new ideas.
From the above it is creative thinking is the ability to think for someone to develop the power of reason, thus bringing forth ideas - new ideas that can be used to solve the problem.

Based on the theory study mentioned the Higher Order Thinking Skill or higher level thinking skills is the process of thinking skills in depth and widespread that involves processing seacara information critically and creatively in the face and solve problems that are kompleks.Soal - math problems in addition to test memory and the understanding and application must also be able to test learners up to level HOTS or can test the process of analysis, evaluation and creative. These questions can be designed with the teacher to see the indicator higher order thinking skills that have been formulated before associating it with a verb that included cognitive operations such as analyzing (C4), evaluating (C5) and creates (C6). Here's a list of verbs operations that can be used to form the matter at the level of higher order thinking skills.

Tabel 3.8 Verbs operations of level C4, C5 dan C6 [30]

Analyzing (C4)	**Evaluate (C5)**	**Create (C6)**
differentiating Organize attribute	Check criticize Prove	Build Plan Produce

diagnosing detailing analyze detecting tie Separate	Maintain Validating Support project	Combine devise Reconstruct Make Create abstracting

If the five indicators associated with the verb HOTS operations on HOTS indicator will be formed as follows:

Table 3.9 Gratings Higher Order Thinking Skills

No	Aspects HOTS	Indicator	Alternative operational verbs that can be used
1.	Critical thinking	Linking the relevant information in accordance with the focus of the problem.	Analyze, select, define, combine and categorize
		Assessing the quality of the precision of an idea / ideas.	Distinguish, compare, predict and assess,
		Detecting the presence of consistent and inconsistent data or information received along with good reason.	Prove and criticize.
2.	Berpikir Kreatif	Develop knowledge of the ones to form new knowledge.	creativity, planning, constructing, designing, finding
		Being able to make a conclusion in accordance with the focus of the problem	Generating and making

B. Why choose PBL?

Characteristics of problem based learning that prioritizes real problems in learning, learning is collaborative, communicative, cooperative and inspiring, train students to learn independently and responsibility, to stimulate the curiosity of students in the investigative process and utilize learning resources are varied [31], [32] , [33], [34]. Based on constructivism understand that learning is student center and student should be able to construct his own understanding in building schemes - schemes in mathematics. Problem based learning approach designed to assist students in the learning process of mathematics. Problem based learning approach utilizes real context of learning so as to make the students better appreciate the usefulness of mathematics dikehidupan day - her day, and familiarize students in solving complex problems that require higher-level thinking processes of students. But not all the problems in mathematics can be contextualized, so the use of problem-based learning, must be clever - clever teachers to pick and choose the material characteristics corresponding to problem-based learning. Problem-based learning when viewed from characteristics is appropriate when applied in the study of mathematics, because mathematics is essentially abstract so as to comprehend the students need to approach the real context in order to be meaningful and useful mathematical material. The advantages of problem based learning according to [31]: (1) it develops students problem - solving skills, (2) it develops sociability level and communication skills, (3) it develops students high-level thinking and critical thinking, (4) it united theory and practice, (student acquire the skills of time management, focusing, the data collection and evaluation report preparation. step - step problem-based learning, namely:

Table 1.1 Steps of problem based learning

No	Steps	Learning activities
1	Presents a problems	Teachers presents problems associated with real world context
2	Merencanakan strategi	Students on the settlement plan that has been accepted
3	Melakukan investigasi	Student and his group find and use various sources, both from books, the Internet or other sources that support problem solving
4	Presenting the works	Processing data later Students present the results of discussions that have been in if the group
5	Evaluate	Students reflect on the results and the process of problem-solving

C. Role Important Scientific Approach

Adopt a scientific approach of the scientific method, prior to be studied more deeply about scientific then we need to know what science is ?, Scientific involve all knowledge contained therein, according to [15]: "science is the activity the which aims to further our understanding of why things happen as they do in the natural world ". The point is that science is an activity that aims to expand / develop an understanding of why - it happens as it happens in nature. From this scientific opinion teaches us to think why something is happening ?, and why? then what about the solution of the problems which have occurred ?. From here students are encouraged to think radically and critically. Experts have different versions - depending on the definition of the scientific method. [35] states that: "scientific method is oversimplified and given too much precedence in science teaching. The version presented here is more complex, allowing for divergence from a set of specific rules ".

According to [16] of the scientific method is a scientific method often used by scientists to analyze the problem and found a solution scientifically. Then, according to [35] states that: "The" scientific method "seems to be an insignificant part of science in a system where the essential finding may be withheld if the" right "answers are not forthcoming". The meaning of this quote is the scientific method seems to be an important part of the science in a system to find the correct or tidaknay an opinion / answers that are useful in the present life and future. The scientific approach used in the curriculum K13 now basically refers to the scientific method used by scientists to study the problem of scientific excellence approach saintific namely the advantages of encouraging and inspiring students to think critically, to inspire learners are Able to think hypothetically see the different, similarities and link to one another on the substance of learning materialsLangkah in scientific approach, namely:

Tabel 1.2 Steps of Scientific Approach

No	Tahap	Aktivitas pembelajaran
1.	Obseving	Seeing, hearing, reading, listening (sign and instrument)
2.	Questioning	Asking questions of a factual question to the question hypothetical. Beginning with the guidance of teachers to independently
3.	Assocciating	Determining the necessary data from questions Specifies the data source either from books, the Internet and books other than textbooks.
4.	Reasoning	Analyzing the data into categories, define data

		relationships, concluded from analysis of data from the data structure that is simple to the complex
5.	Communicating	Delivering results conceptualization in writing, orally or pictures and diagrams.

III. CONCLUSION

Based on the characteristics and advantages of each of the two approaches, problem-based learning and scientific approach can both be used as an alternative approach to learning that can improve students' higher order thinking skills, especially in mathematics. Theoretically and supported by the results of relevant research, the problem-based learning is more effective than a scientific approach, it is because the problem based learning using real context in the learning process, so that students can imagine what will be learned.

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ME – 09

The Excellence of Realistic Mathematic Education based on Gardner's Multiple Intelligences Theory through Mathematical Connection Ability

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Abstract—The aims of learning mathematics is to develop various aspects. One of them is cognitive. One important ability of students'cognitive aspect in learning mathematics is mathematical connection. Therefore, we need a method to develop student's mathematical connections. In mathematics, one method that can be used to develop student's mathematical connection is RME (Realistic mathematic education)-based Gardner's multiple intelligences (MI). RME can be defined as an approach in learning mathematics using realistic situations or problems in the learning situation so that students understand mathematical concepts. In RME-based multiple intelligences by Gardner, teachers provide realistic problems and diverse learning activities in every meeting. How RME-based Gardner's MI can develop students' mathematical connections in mathematics? This paper will give an explanation through the study of literature.

Keywords: *mathematical connection, realistic mathematic education, Gardner's multiple intelligences*

I. INTRODUCTION

One of the efforts to improve the human resources quality is education. Learning in school is way to realize it. One of the compulsory subjects taught in school is mathematics. In fact, the acquisition of Indonesian student in math scores is low. Based on the results of the Programme for International Student Assessment (PISA) in 2012, Indonesia ranks 64 out of 65 participating countries with an average acquisition in mathematics is 375 [2]. PISA is intended for students in the age range of 15 years.

National Council of Teacher of Mathematics state 5 standard reference processes that need to be studied in mathematics, i.e mathematical problem solving; mathematical reasoning and proofing; mathematical communication; mathematical connections; and mathematics representation. One of the skills that students need to have in learning mathematics is the mathematical connection. Therefore, it is very possible that the low math achievement of students is caused by lack of mathematical connections. Students with high math connection capabilities will easily solve a math problem because basically the mathematical concept has been linked one to another.

There are many things that can be done by teachers to improve student mathematical connections. One of them is learning approach. In choosing a learning approach, teachers need to pay attention on student characteristics. Realistic Mathematics Education (RME) approach is still relevant to be applied for junior high school students who are the concrete operational thinkers or even just starting to formal operational thinking [4]. RME is a math learning approach which is first introduced and developed in the Institute Frudhental Netherlands in 1970. This learning approach originates from two main ideas of Hans Frudhental i.e mathematical problems should be linked to realistic context and mathematics as a human activity.

In addition, each individual in the class has a variety of intelligence that can not be overlooked in learning. There are students that are easier to learn with music, some of them like learn mathematics with pictures, some like to learn in groups, and so forth. It is associated with Howard Gardner's theory on MI.

Learning using Realistic Mathematics Education approach based on Multiple Intelligences theory needs to be applied. RME is expected to increase mathematical connection ability and multiple intelligences theory makes students enjoy studying mathematics, so it is easy to accept.

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Theoretically, how could Realistic Mathematics Education based on the theory of multiple intelligences develop students' mathematical connection capability? The explanation on the matter is expected to give an idea how to develop students' mathematical connections through Realistic mathematics education approach based multiple intelligences theory as well as how to implement it in the teaching learning mathematics.

II. Discussion

A. *Realistic Mathematics Education (RME)*

RME is one of mathematics approaches which was first introduced and developed in the Institute Frudhental the Netherlands in 1970. The learning approach originates from two Hans Frudhental's main ideas that mathematical problems should be linked to realistic and mathematics as a human activity. This approach uses realistic problem to help students construct mathematics concepts. The problem is not always the realistic one that exists in the real world (real world problem) and can be found in student's daily life. A problem is called realistic if it is imaginable on student's mind. Meanwhile, as the activity, students should have the experience or the opportunity to do the experiment to construct their knowledge [5].

Learning using RME should contain the characteristics of the approach. Treffers in [6] mentioned 5 characteristics of RME, as follows:

1. Context Use

   Context is a bridge for students to understand mathematical concepts. Context used as a realistic problem should be imaginable for students.
2. The use of mathematical models for Progressive mathematization

   Refers to [7] RME is a model of learning that guides students from the informal into formal knowledge. Students face contextual issues then a model is developed based on the issues. Next, the model will be developed using mathematical reasoning in order to obtain formal mathematics.

   The process above is called mathemazation. [8] argues that the mathematization is the process leading to the mathematical concept from the real problems which are close to students' lives. There are two types of mathematizations: *When this actively of mathematizing applies to a subject matter of reality, we call it horizontal , and when it applies to a mathematical matter one speaks of vertical mathematization.*

   It can be concluded that the mathematization is a process of informal to the formal mathematics. Based on the classification, horizontal mathematization directs students to identify the real context and translate it into mathematical language to make it more understandable to complete. Vertical mathematization also rests on contextual problem until it can arrange a specific procedure to resolve the problem without starting by context.
3. The Utilization of Student's Construction

   Mathematics is not a finished product. Students are given the opportunity to construct knowledge through exploration. The results of their findings are the basis for building a mathematical concept.
4. Interactivity

   Group activities, the indirect negotiations, and discussions are very important activities in the process of knowledge construction. It is an informal method for students in acquiring formal knowledge.
5. Intertwining

   Single mathematical concepts are not enough to apply the concepts and problem solving. Intertwining is needed in solving mathematical problems.

B. *Multiple Intelligences(MI)*

Intelligence is the ability to apply knowledge and experience to face the challenging tasks flexibly [4]. Howard Gardner [9] stated that, *Intelligence is the human ability to solve problems that are valued in at least one culture*. Furthermore, refers to [10] states that MI are the ranges of students' skills and talents to solve problems in learning process. In conclusion, intelligence is the ability to solve the problem that could be different from one person to another. This is talent as well.

Howard Gardner, in his book "Frames of Mind", suggests that there are nine kinds of intelligence of human beings that form multiple intelligences. Here are nine multiple intelligences, the characteristics, and ways to employ in teaching-learning process:

1. Verbal-Linguistic intelligence
   People who have this intelligence tend to have a high ability in reading, writing, and talking. In mathematics, students can be encouraged to understand certain concepts through poetry.
2. Logical-mathematical intelligence
   People who have this intelligence have the ability to make mathematical calculations, deductive and inductive reasoning, build logical relationship, to propose hypotheses, to solve problems, to think critically, and to understand the numbers, geometric shapes, and abstract symbols.
3. Visual spatial intelligence
   Visual spatial intelligence is the ability to make visual representation in mind, or the ability to dream, to imagine, to think with drawings, lines, shapes, and so forth. Teachers can present learning materials in graphs, pictures, and diagrams to make visual spatial students more easily understand.
4. Musical-rhythmic intelligence (musical intelligence)
   Musical intelligence is related to rhythm, sound, tones, and music. Children who have musical intelligence has ability to play an instrument, to sing a song and write songs. To facilitate students with musical intelligence in learning mathematics, teacher can introduce the mathematical material through song.
5. Bodily kinesthetic intelligence
   Bodily-Kinesthetic intelligence is an ability to move, make gesture and facial expression, using the effective coordination between brain and body, and produce all or part of the body movement. In mathematics, this intelligence can be facilitated with a hands-on activity and by letting the child learn with some learning instruments.
6. Intrapersonal intelligence
   Interpersonal intelligence is the ability to understand and distinguish emotions, aspirations and needs of the environment. To facilitate this intelligence, teacher can use some cooperative model learning.
7. Intrapersonal intelligence (intrapersonal intelligence)
   According to Gardner, intrapersonal intelligence is the kind of intelligence that is the most important in life. It is enables person to understand and be responsible with theirself. Students with this intelligence can be given the opportunity to learn on their own first before learning in groups.
8. Naturalistic intelligence (naturalist intelligence)
   It is the ability to identify and find objects in nature and thinking life form. Outdor learning is one way to facilitate students with this intelligence.
9. Extensialist Intelligence
   Ekstensialist intelligence is the ability to question everything. Intelligent people tend to question why something happens, the reason of some event, and curious about everything. To facilitate the students with this intelligence, teachers need to understand and prepare the answers of teaching materials [11].

C. Mathematical Connection

Mathematics is often seen as as an unrelated set of skills or activities. A person who visualizes math only as a collections of facts, capabilities, and procedures will find it hard to achieve a deep understanding of mathematics. Mathematics is not a collection of separate topics, but a thorough knowledge and mutual connections [12]. Refers to [3] defined five standard capabilities that must be possessed by students in learning mathematics: problem solving, reasoning, communicating, making connections, and making representations.

Mackanong in [13] states that "mathematical connection was learners' abilities to link the previous of their mathematics knowledge and problems gained from classes to the current problem or situation with the which they were dealing." This means that the mathematical connection is the ability to connect the mathematical knowledge they already have in long-term memory into a situation or problem they are facing.

Hiebert & Carpenter in [14] suggest that making a connection process in mathematics is the core of developing mathematical understanding. Teacher should facilitate students to make connection so that students can find meaning in learning. Refers to [15] state that a student will actually have a relational understanding (knowing what to do and why) in the learning process if they do not just memorize or remember the material being taught, but also can connect the concepts or new procedures with ideas owned by the students beforehand. Mathematical connections allows students and teachers to discover mathematics in daily life, especially everything related to the life and interests of students, the relationship between mathematical concepts and mathematical relationships with subjects or other disciplines [16].

Based on [17] argues that the correct relation can build conceptual understanding. The more powerful students make connection between interrelated concepts, then the understanding gained will be deeper and richer. In essence, a person will gain an understanding of new concepts and build it through connection with the previous concept. The person will add and develop an understanding of the new concepts as well.

Refers to[3] states that a person is able to perform mathematical connection, if: (a) be able to recognize and use connection among mathematical ideas; (b) understand how mathematical ideas are interconnected and built on one other to produce a coherent result; (c) recognize and apply mathematics in contexts outside of mathematics.

According to [18] study of mathematics will be effective if the learning process facilitate students to do some of the connections as follows:

1. Establishing a connection between student's initial knowledge with concepts and new abilities.
2. Connecting intuitive knowledge with formal mathematical/ abstract.
3. Connecting several mathematical representations, concrete activities, the language of mathematics, and certain symbols.
4. Connecting between topics in mathematics.

The characteristics of people who have mathematical connection ability can be identified, as: capable to connect mathematical concepts or mathematical ideas that students already have into mathematical problems being faced, capable to connect some concepts or mathematical ideas that students already have into the contextual issues that related to daily life, and capable to connect concepts or mathematical ideas that students already have into the problems associated with other disciplines. From some of these characteristics, the mathematical connection indicators are as follows:

1. Connecting concepts or mathematical ideas with mathematics problems.
2. Connecting concepts or mathematical ideas to problems in the context of everyday life.
3. Connecting concepts or mathematical ideas to problems in the context of other disciplines.

D. The Excellence of Realistic Mathematic Education based on Gardner's Multiple Intelligences Theory through Mathematical Connection Ability

RME has five characteristics. One of the characteristtic is the ability to connect the realistic problem with the students previous knowledge. RME approach that emphasizes problem solving can not be separated from the connection process. RME with realistic problems require students to be able to resolve the problem by changing into a mathematical form, and connect the problems with the mathematical concepts owned by the students. Multiple activity based on multiple intelligences will help students develop the mathematical connection capabilities. It aims to connect their activities with the concepts they learn. The activities will vary significantly if students can relate to the mathematical concepts that are being or have already learned.

According to [19] argues that to facilitate students connection, mathematic teacher should be able to encourage students to undertake investigative activities, link mathematics, to facilitate the students to be able to select the appropriate method to give a reason and idea, and to judge their decisions in resolving a problem. RME is the best approach because it enables students to explore, to connect concepts with methods/strategies as appropriate, as well as to provide ideas in group discussions. In conclusion, RME approach based on multiple intelligences theory can promote students mathematical connection.

Here are the steps that teacher can practice in the teaching and learning mathematics.

1. Understanding realistic problem
   Teacher given the realistic problem to be understanding by the students. The realistic problem should be in multiple context. Multiple context will facilitate the students with multiple intelligences. In this phase, teacher give a simple explanation about the problem to the students.
2. Solving the realistic problem
   Teacher can facilitate intrapersonal or interpersonal intelligences in this phase. Teacher give a chance for students to think individually or by group discussion to solve the problem, and using students logical mathematical intelligences to make mathematical modeling about the realistic problem to get the solution. In this phase, students have to make connection about the problem and the concept they should use to solve the problem. This also can promote students mathematical connection.

3. Comparing Result and Making Conclusion
   In the last phase, students have to present their discussion in the class, comparing with the other, and teacher clarifying the correct result. And last, the students and teacher making conclussion about the topic, what they have learned. This phase is appropriate with the interactivity principal of RME.

Here is the example of realistic problem about area of circle that related to the the concept of area of rectangular and the concept of arithmetics.

"*A rectangular garden in Yogyakarta have dimension 15 meter × 9 meter. There is a fountain pool in circle shape in the center of the garden. The diameter of the pool is 9 m. That garden will be palted with the grasses except the pool. If the cost needed is Rp105.000,00 for every 1 meter square, determine the whole cost to plant the grasses.*"

To solve the problem above, students have to connect the real problem to the mathematical concepts, and also have to connect the concept of area of circle with another concept, such that area of rectangle and social arithmetics.

III. CONCLUSION

Realistic mathematics education approach based on Gardner's multiple Intelligences theory can make student's mathematical connection ability excellent. Therefore RME learning progress should contain 5 characteristics including intertwining. That means, one material should be connected with others and students should have mathematical connection ability to do that. The mathematics materials are found by an exploration and mathematization progress, so they will not memorize only but also understand. Furthermore, learning process based on Gardner's multiple intelligences will make students enjoy because they learn with various activities they love.

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Characterization of Mathematical Connections in Calculus

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Abstract**—**This paper aims to determine the types of mathematical connections when undergraduate students solve connections problems in calculus, and to describe the characteristics of each type of the connections. The approach of this research is qualitative research with descriptive exploratory method. Itsparticiants were undergraduate students of Mathematics Education Study Program, Faculty of Teaching and Education, University of Mataram in Academic Year 2015/2016. Data of research collected through the connections assignment sheet in calculus and followed up by interview based on the tasks. The study resulted that the type of mathematical connection can be characterized into two types, that are the proceduralconnections and the conceptual connections. Each of these type links two or more topics among some topics in calculus. In the future studies, result of this characterization will bedetailed schematically to describe its process of thinking.

Keywords:*calculus, characterization, mathematical connections.*

I. INTRODUCTION

When learners solve a problems, it was often happened that they already have learned and mastered the knowledge required to solve the problem, but they can't associate or make a connection and use it to solve the problem. Therefore, the ability of mathematical connections needs attention in the learning of mathematics. Mathematical problems solving need skill to connect mastered knowledge relating to the problems encountered.

Mathematical knowledge can be divided into two types, namely conceptual knowledge and procedural knowledge [1]. The core of conceptual knowledge is to understand the relationship between ideas and mathematical concepts. The purest form of procedural knowledge focuses on the symbolism, skills, rules and algorithms used step by step in solving a mathematical task. Learners should learn the concepts at once with the procedures so that they can see the connection.

Concepts, procedures or skills, along with facts and principles identified by Gagne as the direct object of mathematics [2]. While the one of indirect objects of the mathematical is problem solving. Problems are questions that can be understood by learners but can not be answered immediately with a routine procedure that has been known to learners. So a question can be clasified as a problem when the questions give a challenge to be answered and the answer can not be done by a routine strategy. Solve the problem is the process of accepting the challenge to answer the question that is the problem [3]. A problem for college students when administered to elementary level students excluding a problem because the problem will not be understood and will not give a challenge to be answered.

Bruner's connectivity theorem stated that in mathematics every concept related to other concepts. Similarly, between the argument and the other argument, the theory with the other theory, among the topics to the topic, and between branches of the branch of mathematics sholuld be related [4]. Therefore, in order to be more successful in learning mathematics, learners must be given the opportunity to make mathematical connections.

Connection mathematically described by [5] as part of the network is structured like a spider web, "*The junctures, or nodes, can be thought of as pieces of represented information, and threads between them as the connections or relationships*". Mathematical connections can also be described as a component of a scheme or a linked group of schemes in mental network. Reference [6] argued that the characteristics of the scheme is the connection. The more connections, the greater compactness and strength of the scheme.

Studies on the connection mathematical beside conducted in schools are also a lot done in universities [7], [8], [9], [10]. According [11], which examines undergraduate students in pre-calculus course concluded that the subjects had not yet established a connection between algebra procedures and the nature of the underlying numbers. Results of research on the connection in linear algebra carried out by [12] showed that subjects find it more difficult to make the connection between concepts like eigenvalues and eigenvectors and of other parts such as the conceptual basis and the dimension.

Research by [13] on middle school pre-service teachers has resulted five categories of mathematical connections, namely: (1) *categorical*, if the paticipant's explanation relied upon the use of surface features primarily as a basis for defining a group or category; (2) *characteristic/property*, if the participant's explanation for the sort involved defining the characteristics or describing the properties of concepts in terms of other concepts; (3) *curricular*, if the participant's explanation for the sort involved relating ideas or concepts in terms of the impact to curriculum, including but not limited to, the order in which one would teach concepts or topics; (4) *procedural*, if the participant's explanation for the sort involved relating ideas based on a mathematical procedure or algorithm possible through the construction of an example, which may include a description of the mechanics involved in carrying out the procedure rather than the mathematical ideas embedded in the procedure; and (5) *derivational*, if the participant's explanation for the sort involved knowledge of one concept(s) to build upon or explain other concept(s), included but not limited to the recognition of the existence of a derivation.

Results of another study suggests three types of connections, that are referred to the most commonly in relevant literature and in their formal curriculum documents, but in practice their development of "connected knowing" could have been stronger, more frequent and more consistent. The three kinds of connections are the connection between new information and current knowledge, the connection between mathematical concepts, and the connections to everyday experience [14]. The types of connections is in line with the scope of connection standards in the [15], which include recognize and use connections among mathematical ideas, understand how mathematical ideas interconnected and build on one another to produce a coherent whole, recognize and apply mathematics in contexts outside of mathematics.

Study of the source of theory and the previous research results presented above, gave rise to the idea of mathematical research with the theme of connections. The connections studied is considered by knowledge of mathematics that divided into two types of knowledge, namely conceptual knowledge and procedural knowledge. Therefore, research on the characterization of the mathematical connections when undergraduate students solve problems about calculus was conducted. The material of calculus is chosen because it is the core material in mathematics educations program, and a lot of good use in other disciplines as well as in everyday life.

This research is expected to be useful among others, to provide an overview of the undergraduate students about the characterization of mathematical connections, so it can be used as a benchmark to improve problem solving skills. In addition, it is expected to be useful as well as inputs for lecturers or teachers of the importance of undergraduate students making mathematical connections so that it can be taken into consideration in planning and implementing learning.

II. METHOD OF RESEARCH

Type of research is descriptive exploratory study. The participants were six undergraduate students of Mathematics Education Study Program, Faculty of Teacher Training and Education, University of Mataram in Academic Year 2015/2016. The main instrument in qualitative research was a researcher itself [16]. The support instruments are an assignment sheet and an interview guides. The assignment sheets gave a task of connection on calculus in the form some cards with information written on it. Informations on these cards can be facts, a concepts, principles, procedures, or problem about calculus. The cards are considered as nodes that shoul be connected.

The tasknumber 1, contain two cards, consist of information about The Pythagoras Theorem and a point (x, y) at Cartesius coordinate system that satisfy $x^2 + y^2 = r^2$, where $r > 0$.The task number 2 consist of three cards that each contain information about concepts, that are absolute value function, derivative of function, and graph of function. The problem structure of task number 1and number 2 is describedin Figure 1 and Figure 2.

Mathematical connections made by participants are grouped and identified its characteristics. Judging from the type of knowledge conceptual and procedural knowledge, this type of mathematical connection divided into two types, namely conceptual connections and procedural connections. While looking at the material, there are some topics related material, for example: Pythagoras theorem, Cartesius coordinate system, absolute value function, graph of functions, and derivative of fuctions.

In the Fig. 1, a participants that make connection inter nodes by similiraty formula is catogorized as procedural connections, meanwhile if a participants connect two nodes by plotting the right triangle at the

Cartesius coordinate plane that contain the circle with center O and radius r then it is categorized as conceptual connections.

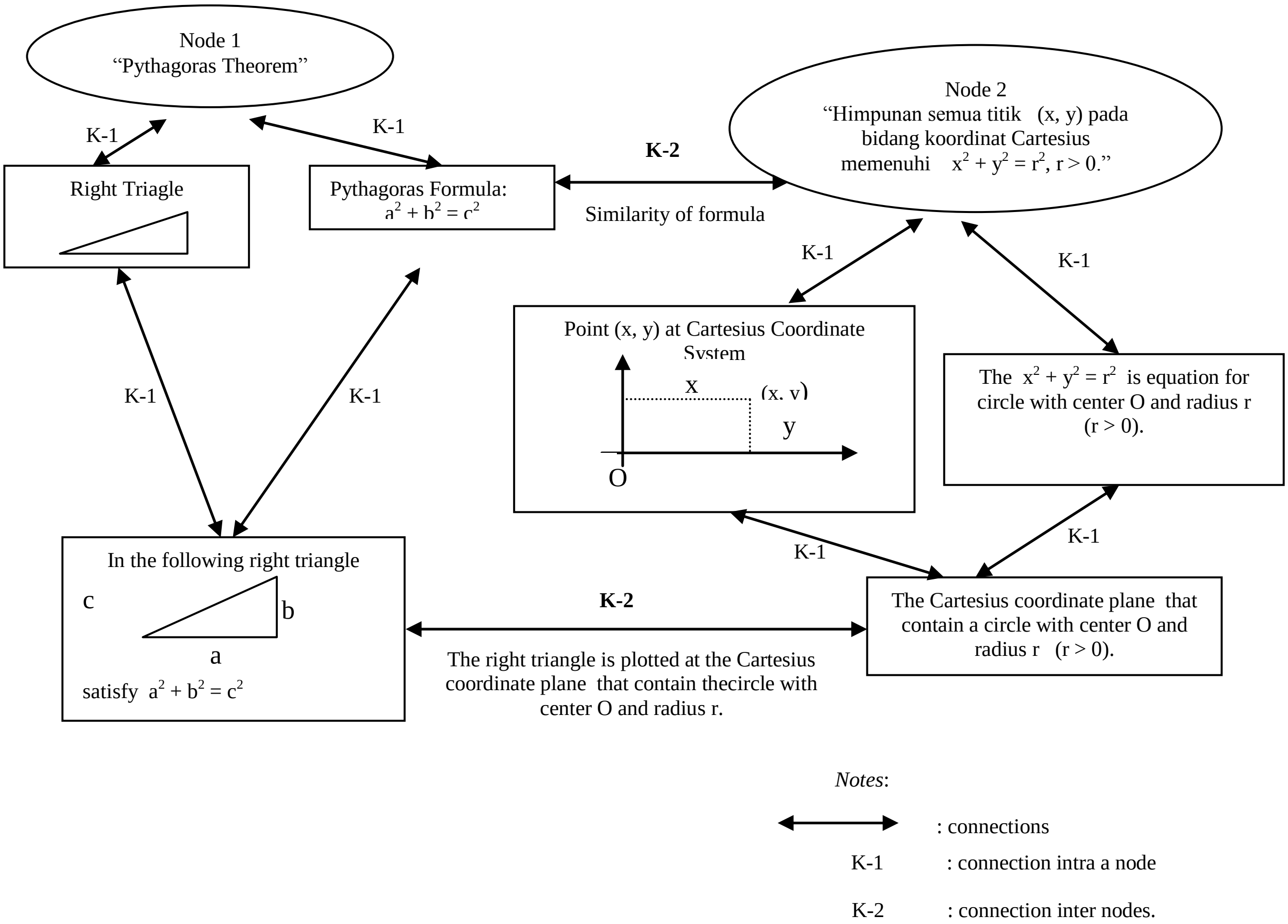

FIGURE 1. THE PROBLEM STUCTURE OF TASK NUMBER 1

In the Fig. 2 below, a participants that make connection inter nodes by compute derivative without consider geometrically interpretation is catogorized as procedural connections, meanwhile if a participants make connection inter nodes by compute derivatives, then consultated with geometrically interpretation is categorized as conceptual connections.The indicators of the type of mathematical connection can be expressed in Table 1.

TABEL 1. THE INDICATORS FOR TYPES OF MATHEMATICAL CONNECTIONS

No.	Type of Mathematical Connections	Indicators
1	Procedural Connection	• To connect the Pythagoras theorem with point (x, y) at Cartesian coordinate system that satisfy $x^2 + y^2 = r^2$by similarity formula. • To connect the absolute value function with derivative of function by count its derivative without consultated its graph. • To connect the absolute value funtion with graph of function by draw its graph without analize it. • Not make connection between derivative of function with tangent slope of function.
2	Conceptual Connection	• To connect the Pythagoras theorem with point (x, y) at Cartesian coordinate system that satisfy $x^2 + y^2 = r^2$by plotting the right triangle at the Cartesian coordinate plane that contain the circle with center O and radius r. • To connect the absolute value function with derivative of function by count its derivative and consultated its graph. • To connect the absolute value funtion with graph of function by draw its graph, then analize it.

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		• Make connection between derivative of function and tangent slope of function, then look smoothness the graph.

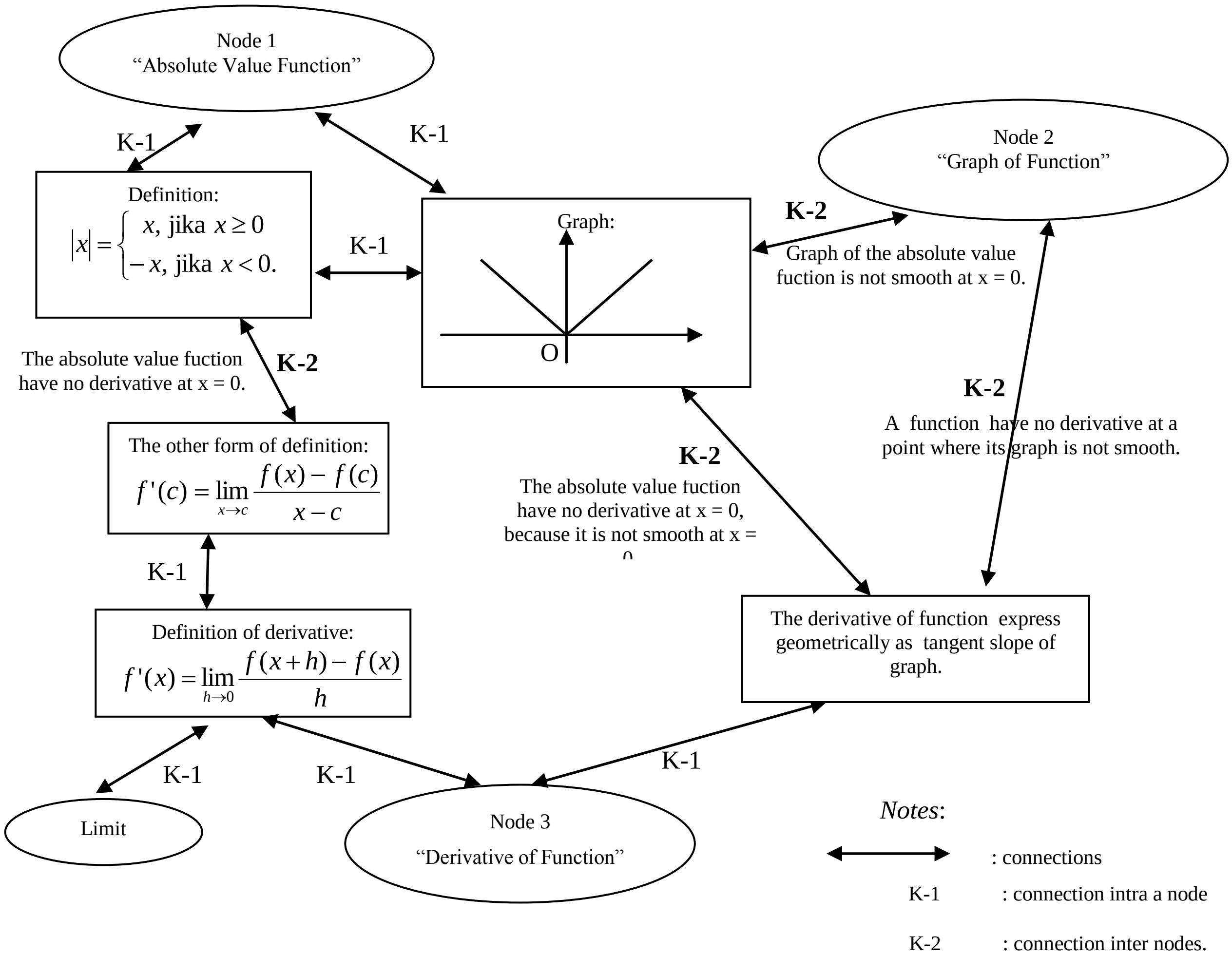

FIGURE 2. THE PROBLEM STUCTURE OF TASK NUMBER 2

III. Result and Discussion

The results of the participants' answers to the connection task recapitulated based on aspects of conceptual connection and procedural connection. There are some topics related to the material, which arePythagoras Theorem and Point in Cartesian coordinate system at task 1, meanwhile material in task 2 include absolute value function, derivatives and graph. Responses of participants is presented in Table 2 below.

Results of analysis of the data resulted in grouping type of mathematical connection, which can be divided into two types, namely conceptual connections and procedural connections. The conceptual connections occurs for participants S1 when make connections between "Absolute Value Function", "Graph of Function", and "Derivative of Function", because after count its derivative,then she draw its graph then analize it, so that can make connection between derivative of function and tangent slope of function or smoothness the graph, as shown in Fig. 3.

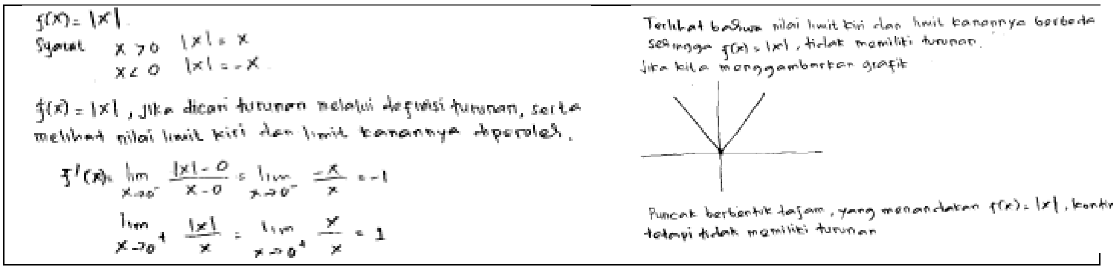

FIGURE 3. PARTICIPANTS' ANSWER THAT CATEGORIZED AS CONCEPTUAL CONNECTIONS

TABEL 2. RESPONSES OF PARTICIPANTS

Participants	Node of Connections	Explaining of Connections
S1	"Pythagoras Theorem" and "An arbitrary point (x, y) at Cartesian Coordinate System satisfies $x^2 + y^2 = r^2$, where $r \geq 0$"	Pythagoras theorem entitled at a right-angled triangle. The right triangle is drawed with O (0,0) and (x, y) as the vertex and sides are respectively x, y, and r.Therefore, the equation $x^2 + y^2 = r^2$ is the form of Pythagoras Theorem, where $r \geq 0$ is distance from original point (0, 0) to point (x, y).
S1	"Absolute Value Function", "Graph of Function", and "Derivative of Function"	Graph of the absolute value function depicted shaped sharply, indicating continuous but has no derivative. The absolute value function has no derivative at x = 0. It is calculated using the definition of derivative obtained limit value of the left and right limits are different.
S2	"Absolute Value Function", "Graph of Function", and "Derivative of Function"	Expressed $f'(x) = \|x\|/x$, but can not give a reason.Graph illustrates the absolute value function sharp angle, signifying nothing derivative in that.But for the general functions, such as quadratic functions, she can not give the interpretation of the derivative in terms of the graph of a function.
S3	"Pythagoras Theorem" and "An arbitrary point (x, y) at Cartesian Coordinate System satisfies $x^2 + y^2 = r^2$where $r \geq 0$"	Pythagorean theorem is the distance of points (x, y) in Cartesian coordinates satisfy $x^2 + y^2 = r^2$, $r \geq 0$. The right triangle is drawed in the Cartesian coordinate system with O (0,0) and (x, y) as a point angles and sides are respectively x, y, and r.
S4	"Absolute Value Function", "Graph of Function", and "Derivative of Function"	The absolute value function is a function that its graph is above the x-axis. Derivative of a function can be illustrated in a graph of a function. Absolute value function is a function that can be derived and the function can be described in a function.

The procedural connections occurs for participants S1 and S3 when make connections between "Pythagoras Theorem" and "An arbitrary point (x, y) at Cartesian Coordinate System satisfies $x^2 + y^2 = r^2$, where $r \geq 0$", because they only look similarity formula without plotting the right triangle at the Cartesian coordinate plane that contain the circle with center O and radius r.Connections between "Absolute Value Function", "Graph of Function", and "Derivative of Function" maked by participants S2 and S4 is categorized as the procedural connections too, because S2 expressed $f'(x) = |x|/x$, but can not give a reason and S4 can not make connection between derivative of function with tangent slope of function. The examples of procedural connections is shown in Figure 4.

FIGURE 3. PARTICIPANTS' ANSWER THAT CATEGORIZED AS CONCEPTUAL CONNECTIONS

IV. CONCLUSIONS

From the results of this study concluded that the type of mathematical connections when undergraduate students solve problems in topics of calculus can be divided into two types, that are conceptual connections and procedural connections. Characterization of each type of mathematical connections in terms of topics related, that are Pythagoras theorem and point at Cartesian coordinate system,as well as absolute value function, derivatives and graph. The implications of this study are expected that lecturers need to provide problem-solving issues that are non-routine and requires undergraduate students to explore mathematical ability as a whole in order to make the mathematical connections which is a tool in problem solving.

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ME – 11

The Effect of Problem Based Learning to Mathematical Reasoning Abilities of High School Students
Topic: Series and Sequence

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***Abstract*—** Knowing the information from the reality on the school that the mathematical reasoning students in class X is still less. Motivation and activity of students in the learning of mathematics is also less. Based on this background the purpose of this study is to determine whether there is influence the activity of students using problem-based learning in the ability of the mathematical reasoning students, whether in mathematics using problem-based learning can achieve the criteria completeness minimum (CCM), and to investigate the activities of teachers and students during the learning takes place. The method used in this research is the experimental method. In doing in class X SMA Negeri 1 Jalaksana Brass in the academic year 2013/2014. Selection of the samples in this study conducted with a purposive sample technique to make the class X-3 as the experimental class using problem-based learning and class X-2 as the control class by using conventional learning with expository. The instrument used for data collection in this study is an essay test in accordance with the indicators of mathematical reasoning to the material Exponent, The Roots and logarithm. Tests are given consists of 7 questions of reasoning. The results showed a positive effect of the activity between the use of problem-based learning to students' mathematical reasoning abilities. This is evidenced by the size of the acquisition value over the average posttest experimental class than the control class. Knowing the positive value of the coefficient update equation linear regression model that explains the meaning of the positive value of the activity of students in problem-based learning process a positive influence on students' mathematical reasoning abilities. The achievement of CCM using problem-based learning.

Keywords: *influence, problem based learning, mathematical reasoning.*

I. INTRODUCTION

In the era of global information, people are required to have the ability to acquire, select, manage and act on that information to be used in a dynamic life and full of challenges and competition. A dynamic life demands that we have a critical ability, this ability can be developed through learning mathematics.

Mathematics in schools (Depdiknas, 2006) are (1) train the way of thinking and reasoning to drawing conclusions. (2) develop a creative activity that involve imagination, intuition, and discovery by developing divergent thinking, original, curiosity, make prediction and expectation, as well as trial and error. (3) develop the ability to convey information and communicate ideas. The explanation can be said that there is a close relationship between the formation of human character which is expected by the learning of mathematics, so that the learning of mathematics must be given to all students without exception to be trained to think logical, analytical, systematic, and creative.

Learning mathematics based Education Unit Level Curriculum current is intended that learners have the capability of understanding the concepts, reasoning, problem solving, and mathematical communication. By not ignoring other skills, reasoning ability plays an important role in the learning of mathematics. The ability to reason is not only required students as they learn mathematics and other subjects, but also is needed for every human being at time when its own decisions. Reasoning ability is also necessary in order to achieve better results in solving a mathematical problem. Therefore, we need to realize that the reasoning skills should be ~~is~~ grown within the individual student.

Based on discussions with the author of a mathematics teacher in class X SMA Negeri 1 Jalaksana Brass obtainable information that mathematics learning activities include students have difficulty to solve problems that require analytical reasoning. A number of students who have understood the theoretical mathematical topic was experiencing difficulty when questions or problems presented in the form of analyze. Reality on the ground students simply memorize concepts and less able to use these concepts when they have a problem in real life. According to the survey, several high schools in West Java Kuningan area, generally the teacher explains concept be informative, giving the example problems, and provide exercises. The tradition of teaching such as this is a common characteristic for teachers implement mathematics in Indonesia and could be said that conventional mathematics.

Problem-based learning model is expected to be a solution or alternative in this research for teachers in order to improve students' mathematical reasoning abilities. Based on the above, the authors are interested in conducting research on "The Effects of Problem Based Learning Mathematical Reasoning Ability Of High School Students (Research Experiments in Class X SMAN 1 Jalaksana Brass)."

II. RESEARCH METHOD

This study used a study design shaped pretest-posttest control group design. In accordance with the study design used, this research involves two classes of experimental class and control class. To saw the effect of problem-based learning to students' mathematical reasoning abilities pretest and posttest in both classes. The design used appropriate (Sugiono, 2012: 116) could be described as follows.

R O1 X O2

R O3 O4

Information:

R: The sample study were randomized (random)

O1: pretest experimental class

O2: posttest experimental class

O3: Pretest control class

O4: posttest control group

X: Treatment of experimental class

The study population consisted of ten classes with all students numbered 400 students. Based on information from the school, students SMA Negeri 1 Jalaksana Brass had diverse capabilities. The sampling technique in this study used purposive sampling techniques. Based on the opinion of Sudjana (Sudjana, 2005: 168) "The definition of a purposive sample (sample purposive) that sampling based on individual considerations or consideration of researchers." Since the measurement is a measurement of high-level analyze so that researchers would use the excellent class. So that became a purposive sample in this research is class X-3 were used as experimental class learning used problem-based learning with the consideration that the class had an average UN high mathematics, so that assumed to have good reasoning ability. Data analysis was performed in order to draw conclusions with regard to the problem to be solved in the research. The data obtained data about students' mathematical reasoning abilities

Here are the steps performed in the data analysis.

1. Calculate descriptive statistics of mathematical reasoning ability by pretest and posttest, and calculates a score initial reasoning skills and reasoning abilities final score in each class were selected as sample.
2. To determine the increase in students' mathematical reasoning abilities after learning test was used Gain normalized.

3. Perform data normality test pretest, posttest and Gain normalized.
4. To test the homogeneity of data pretest, posttest, and Gain normalized.
5. To test the difference between two average.
6. Scaterplots observations on the value of the activity with the value posttest in the experimental class.
7. Perform simple linear regression test.
8. observations on scaterplots residue obtained from the simple linear regression model.
9. Perform calculations mastery learning outcomes could be seen from the posttest that have reached KKM.

III. FINDING AND DISCUSSION

After collecting the data, the data obtained in the form of initial test scores and final test scores, which average could be seen in Table 1.

Table 1

Descriptive Statistics Data Results pretest and posttest

Statistical Data	Experiments		Control	
	Pretest	***Posttest***	***Pretest***	***Posttest***
Number of Students	40	40	40	40
Largest Data	24	94	24	92
Data Smallest	00	10	00	00
Range	24	84	8,08	27,06
Average	11,72	65,97	11,22	56,07
Standard Deviation	6,88	25,47	8,08	27,06
Variance	47,43	649,20	65,410	732,533

Knowing the information from the test results influence (simple linear regression) showed that there is a linear relationship between student learning activities using problem-based learning with mathematical reasoning abilities of students in the experimental class. R-square values obtained or R2 = 0.817 = 81.7%. These values indicate the size of the goodness of fit between the regression model or data obtained from a class that implements problem-based learning. The R2 also shows the diversity of data able to be explained by the regression model $Y = \alpha + \beta x$. In addition there is a 28.3% variable diversity of data that is not explained by other variables in addition to the attitude shown in the process of problem-based learning.

Information obtained from the equation regression model received is $Y = -170 + 2{,}962x$. The linear regression model equation could be known the acquisition value of a positive coefficient of 2.962. This shows that the influence of the activity of students in problem-based learning activities had a positive influence on students' mathematical reasoning abilities. This means more active in the learning process, the higher the students' mathematical reasoning abilities.

From the acquisition of information regrsi linear model equations are received and information value of R2, it could be seen that there are positive influence between problem-based learning with students' mathematical reasoning abilities.

Teacher activity observation results are presented in Figure 1 as follows.

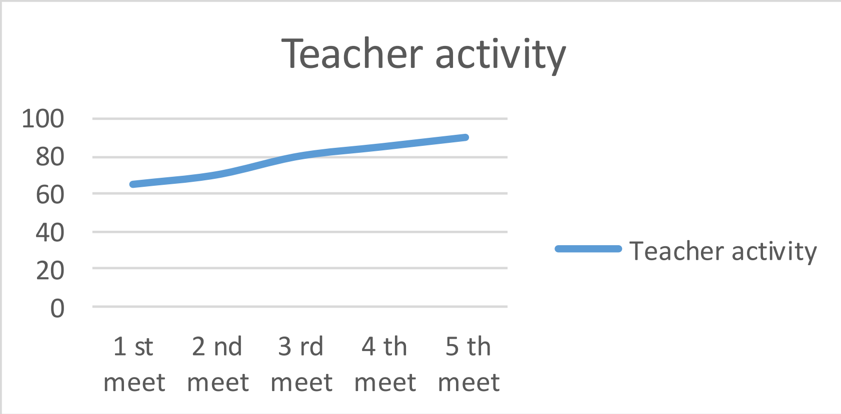

Figure 1 Teacher activity observation results

Knowing the information from Figure 1 and data analysis observation result, the value of teacher activity from the initial meeting until the end of the meeting has increased dikatagorilan good.

Then, from the results of observations on the implementation of problem-based learning at the first meeting until the fifth meeting, the information obtained at the first meeting activity value of teachers is 35 and the percentage is 70%, the second day of the value of the activity of teachers is 39 and the percentage is 78%, whereas the third day activity value of teachers namely 42 and the percentage is 84%. On the fourth day activity value and the percentage of teachers that is 45 to 90%. On the last day that the fifth meeting of the value of the activity of teachers is 47 and the percentage is 94%.

At the initial meeting measures problem-based learning activities that have been going on for quite match the characteristics of problem based learning has been established, but this has not been maximized. However, to further the implementation of learning activities, measures problem-based learning has been more leverage, as seen in the increase in the percentage of activity the teachers obtained.

Student activity observation results are presented in Figure 2 as follows.

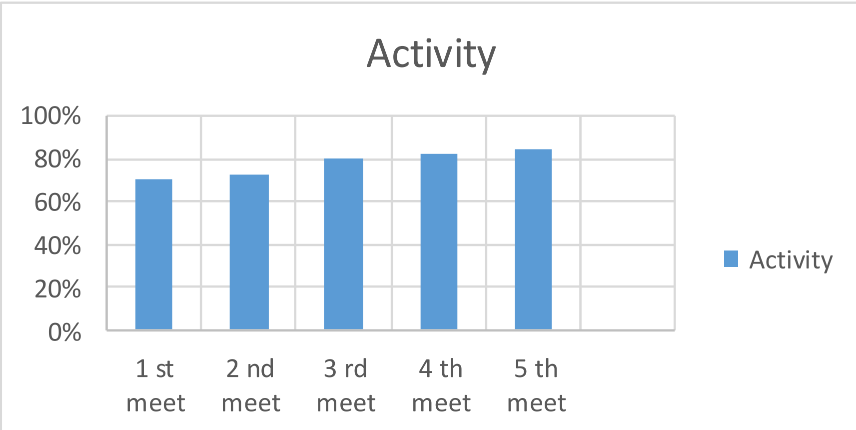

Figure 2 Observations on implementation

Knowing the information from Figure 2 that the results of observations on the implementation of problem-based learning carried out in the experimental class obtained average value activity at its meeting also increasing, with the first meeting obtained a value of 2.81 or 70% were terkatagori good. The second meeting enhancement experienced by 4% of obtaining a value of 2.96 or 74% were good category. The same thing also at the third meeting, namely an increase of 6% from the first meeting, the acquisition value at the third meeting soon is 3.2 or 80% were good category.

Acquisition value at the fourth meeting an increase of 2% from the third meeting, namely 3.33, or 83% were categorized either. At the fifth meeting or end the meeting there was an increase from the fourth meeting of 2%, is to obtain a value of 3.41 or 85% were categorized either. Of all the activities in every meeting obtained by the average value of the activity of 3.15 or 76%, which means the problem-based learning activities held in the experimental class good category.

IV. CONCLUSION AND RECOMMENDATION

A. *Conclusion*

1. Based on information from the analysis of research data shows that the mathematical reasoning abilities of students in the experimental class in mathematics learning problem-based learning used higher when compared with the control classes in mathematics menggunakkan conventional learning is expository. This can be demonstrated by the increase in the average scores of 54.23 to 44.85 for the experimental class and control class, so there is a difference between experimental class control class is 9.38. Aside from the average value of the test, students' mathematical reasoning ability difference between the experimental class and control class can also be seen from the average score of N-Gain. For the experimental class average score of N-Gain is 0.62 while the control class 0.51.Then, based on test results influence (simple linear regression) between the activity of students with mathematical reasoning skills gained sig. 0,000 = 0%. Significance level $\alpha = 0.05 = 5\%$. Because Sig.0,00 <0.05 hence H0 is rejected or, in other words H1 accepted. This suggests the hypothesis proposed by the author proved, that there is the influence of problem-based learning to students' mathematical reasoning abilities on subab "Exponent, The Roots and Logarithms" in class X-3 SMA Negeri 1 Jalaksana Brass. Then the R-square values obtained or R2 = 0.817 = 81.70%. These values indicate that the problem-based learning affects students' mathematical reasoning abilities on the subject of "Exponent, The Roots and Logarithms" As much as 81.70%.
2. Based on the analyze of observational data activity of teachers and students in the implementation of problem-based learning that is applied to the experimental class turns out there is increased activity of teachers and students from the first meeting until the fifth meeting. The average value in every meeting the teacher activity reached 83.2% with good criteria and the average value in every meeting of student activity is 78% with good criterion. At the first meeting of teachers and students are still not used in carrying out the problem-based learning. But at the next meeting of teachers and students have started to understand how the problem-based learning is applied. There is an increased capability of information obtained KKM, when the pretest none of the students who reached the KKM, increased during the posttest students who achieve KKM as many as 24 students. This is because each of their meetings learning, researchers gave exercises in the form of worksheets that settlement of the matter menggarahkan on the characteristics of problem-based learning, as this is routinely done at each meeting so that the students get used to solve problems with the steps of problem-based learning. So as to solve the problems students can do so easily and can increase the yield of each holding of the test. It can be concluded that by using values-based learning can be achieved KKM.

B. *Recommendation*

Researchers only apply problem-based learning in class X SMA Negeri 1 Jalaksana Brass and limited to the subject of "Exponent, The Roots and Logarithms", to the researchers expect the results of this study as consideration for teachers and prospective teachers, so that research can be continued research on the subject of different topics.To foster reasoning abilities in mathematics, especially material related to non-routine matters, teachers are advised to use a problem-based learning to encourage students to be more active to build knowledge and develop mathematical reasoning skills.

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ME – 12

Developing Reasoning Ability and Curiosity of Students toward Mathematics through Problem Based-Learning

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Abstract— Learning mathematics is implemented in schools one of which aims to make the students have the ability to use reasoning and an attitude of curiosity in learning mathematics. Therefore, to be accustomed to using his reasoning, then students should be trained to be able to: (1) find pattern on a mathematical phenomenon; (2) formulate mathematical conjecture; and (3) draw conclusions based on valid arguments. Meanwhile, to increase the curiosity, the students need to be trained to get used to: (1) enthusiastic to learn; (2) trying to understand concepts; (3) happy and studious; (4) trying to find a solution difficulty in understanding the lessons; and (5) use the concept that has been studied previously in understanding new concepts. The ability and the attitude can be trained and improved through learning mathematics in the classroom. One approach to learning that are considered effective for improving reasoning ability and attitude of curiosity of students is a problem based-learning (PBL), because in the PBL the issues presented at the beginning of learning is a real problem or it could also be ill-structured so that learning step the next requires investigation of activities of individual or group that requires them to train mathematical reasoning abilities and stimulate curiosity in learning mathematics. The phases of the PBL approach include: (1) to orient students on the issue; (2) organize the students to learn; (3) guiding the investigation; (4) develop and present work; and (5) analyze and evaluate the problem-solving process.

Keywords: *curiosity, mathematical reasoning, problem based-learning*

I. INTRODUCTION

Permendiknas No. 22 of 2006 on the Content Standards states that the objective of mathematics courses in Indonesia, one of which is that the students have the ability to use reasoning and have respect for the usefulness of mathematics in the life of one of them an attitude of curiosity in learning mathematics. In addition, the learning characteristics that arise during the process of teaching and learning in schools in line with Permendikbud 68 in 2013 such that the learning patterns let a student-centered, interactive learning, students actively construct knowledge-based group, sera shades of active learning and critical , Thus, the proper learning of mathematics is based on competency so that one type of skills required to refer to the higher order thinking skills (HOTS).

Meanwhile, math teacher attention to HOTS students in Indonesia is still low. It is one of them can be seen from mathematical reasoning skills students are generally still low. The fact is, the data shown from the results of a survey conducted by TIMSS (Trends International Mathematics and Science Study) in 2011. Following the survey data in mathematics in terms of three aspects, namely: knowledge, application and reasoning as in Table 1 below (Mullis, Martin, Foy, and Arora, 2011: 150).

TABLE 1. AVERAGE SCORES INDONESIA IN 2011 BASED ON DATA TIMSS

Ordinal	Category of Capability	The Average Score	The Maximum Score	The Minimum Score
38	*Knowing*	378	616	331
	Applying	384	617	316
	Reasoning	388	612	322

Source: TIMSS 2011 Data

Survey data above show that the mathematical reasoning abilities of students in Indonesia is still low, so that Indonesia was ranked 38 out of 45 countries are included. This is due to the value of the average scores obtained by students in Indonesia are below average international score which is below a score of 500.

One approach for effective learning to improve reasoning skills and attitudes curiosity of students is a problem-based-learning (PBL). (Fogarty, 1997) stated that the problem based learning curriculum designed a model using real-life contexts problem. Characteristics of learning can be a problem unstructured, open-ended, or issues that are ambiguous. Moreover, PBL is also one of the recommended approach in the learning of mathematics in the curriculum of 2013. Later, in practice PBL needs to be supported by the existence of the learning device. Importance of learning tools is also stated by Posamentier (2007: 47), who said that although many theories suggest about the best way to teach math to students, so it is generally accepted that learning plans are well designed are the main ingredients of successful learning.

Furthermore fact the field regarding the implementation of the curriculum in 2013 found several barriers for teachers, including teachers difficulty arranging time on lesson plans, planning lessons, planning, the assessment, and the sort of knowledge and skill in the preparation of assessment instruments and time constraints in the implementation of learning, the difficulties associated with the device learning, and difficulty activating students (Heri Retnawati, 2015). In addition, there are other findings about the difficulties of teachers in the implementation of teacher assessment is not yet fully understood. difficulties teachers are also found in: developing instruments attitude, implement authentic assessment, formulate indicators, designing rubrics for skills assessment, and collect the scores of several measurement techniques. In addition, teachers can not find a decent application to describe student achievement (Heri Retnawati, 2016: 390) .Therefore, the corresponding mathematical learning device 2013. The demands of the curriculum need to be developed, especially in this study by using the PBL approach.

II. DISCUSSION

A. *Mathematics Learning*

During the learning process, the thought of giving information and then manage and refine the concept before. Learning does not only include the process of receiving new information, ideas and skills, but the new material is the result of reconstruction or synthesis returned by the mind (Joyce & Weil, 2004: 13). In other words, learning is a process of change of behavior, habits, knowledge, attitude, and the ability of a person towards a better direction. These changes resulted from a series of experiences that involve interaction with the environment and the necessary infrastructure. It shows that the environment and various facilities that support has a very important role in the learning process.

As for the scope of school mathematics, Ebbut and Straker (Marsigit, 2009: 8) defines it as follows: (1) mathematics as search activity patterns and relationships, (2) mathematics as creativity requires imagination, intuition and invention, (3) mathematics as problem solving activities (problem solving), (4) mathematics as a tool to communicate.

B. *Problem Based-Learning (PBL)*

PBL is an approach to learning that is initiated by the filing of the issues or questions that are expected to be completed by the student. PBL uses the context of real-world problems to identify students in identifying researching concepts and principles as well as knowing how the solution through the issue (Duch, Groch, & Allen, 2001: 6). In addition, sometimes the problem situations that arise in the learning process is complex and confusing students that need to be studied to examine linkages with different disciplines, in other words the issue in early learning are sometimes ill-structured or open-ended (Fogarty, 1997). Further characteristics of PBL delivered Arends & Kilcher (2010: 326) includes: (1) problems or issues (learning begins with the filing of the problems in students); (2) authentic (students seeking a realistic settlement to a real problem); (3) investigation and problem solving (students actively involved through a series of investigative activities and problem-solving groups); (4) view interdisciplinary linkages (students explore the standpoint of several disciplines when analyzing the problems in the investigation); and (5) a small group collaboration (learning occurs in the context of a small, in a group consisting of five or six students); and (6) the results of discussions and presentations (students demonstrate learning outcomes by creating products and flaunt it. In many cases, the students present the group's work to her friends or other groups).

With PBL, the focus of mobile learning content or material to the issues such as the following illustration.

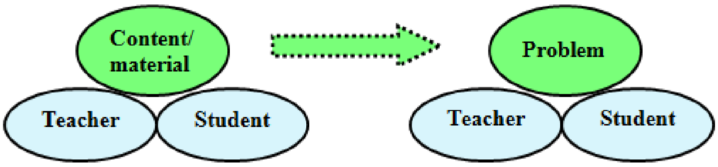

FIGURE 1. FOCUS OF PBL

With the picture above scheme, learning becomes more realistic to create learning that emphasizes real-world, high-level thinking skills, cross-disciplinary learning, independent study, group work skills and communicate through the atmosphere PBL.

TABLE 2. PHASES OF PBL

Phases Of Learnin	Learning Activities
Phase 1: Orient students on issues	The teacher presents real problems through pictures, video and motivate students to perform troubleshooting. Students at this stage make observations on the issues presented.
Phase 2: Organize students to learn	Students in small groups to design steps to resolve problems by collecting information needed by the observations that have been made. Teachers guide students prepare questions and plan for settlement of the issue through the guide in the form of an activity sheet. Students prepare questions to the problems observed.
Phase 3: Guiding investigations of individuals or groups	Students with the group gathered information to conduct an investigation into the problems presented through data or information that has been collected. The data collected is processed to determine the settlement of the problem through investigation. Teachers guide the students carry out the settlement to get a solution to the problem.
Phase 4: Develop and present work	Students communicate the results of the solution to the problems that have been obtained at the front of the classroom or in the other group.
Phase 5: Analyze and evaluate the problem solving process	Students perform evaluation or review of the results that have been obtained. At this stage, teachers guide students in making a final conclusion.

C. *Mathematical Reasoning Ability*

Reasoning ability is one of the important ability to have. Reasoning can be expressed as the science regarding the procedure of withdrawal conclusion (Leighton in Goldstein, 2008: 435). A more complete definition of the reasoning states that the reasoning could be viewed as a cognitive process in which people start with a number of inter-related information further draw conclusions from the information link (Kurtz et al. In Goldstein, 2008: 435). The two statements in line with the suggestion that reasoning is a thought process or activity that seeks the connection between the facts that are known (premise) leads to a new statement or conclusion (Sadiq, 2009: 9).

The process of reasoning to support understanding in mathematics learning and enables students to understand that they learned. This process involves the phenomenon explore, develop ideas, create duagaan mathematics, and the results justify. During the learning process the teacher to help and provide support to students to find the concepts they are learning through exploration. Thus, students can easily understand the mathematical concepts they are learning.

Thus, the opinion of some of the above it is operationally mathematical reasoning referred to in this research include the ability to create a mathematical conjecture, found a pattern on a mathematical phenomenon, draw conclusions from a statement, and provide an alternative for an argument. In other words, the indicators of the ability of mathematical reasoning in this study, are presented in Table 3 below.

TABLE 3. INDICATORS OF MATHEMATICAL REASONING

No.	Indicators Mathematical Reasoning
1.	Finding patterns on a mathematical phenomenon
2.	Formulate a mathematical conjecture
3.	Drawing conclusions from a statement

D. *Curiosity of Students*

Definition of curiosity (curiosity) expressed by many psychologists. (Litman & Spielberger, 2005: 75) defines the attitude of curiosity broadly as a desire to acquire new knowledge and new sensory experiences, which motivate action exploration. In line with this, (Renner, 2006: 305) states that the type of curiosity which is among others include information and new knowledge. A similar opinion illustrates curiosity as an impetus internally to mastery / attainment of knowledge and skills, and it will tend to be reduced in line with the acquisition of knowledge and the results of repetition / exercise (Berlyne, 1954: 180).

Thomas Alva Edison was revealed that the greatest invention in the world one of which is the idea or the ideas of the children and each of the ideas came from a curiosity, so it's important to cultivate curiosity. Moreover, the attitude of curiosity is precisely what has been a lot to contribute in the development of various new discoveries (Stokoe, 2012: 63). Likewise curiosity in learning, critical owned by the students, because with the curiosity would trigger the need for students to learn, investigate or find out. This will lead to an interest to follow up exploration activities or investigation (McElmeel, 2002: 51). In fact, curiosity about something causes a strong desire to understand it.

Curiosity can be increased by connecting the lesson, one of them by hooking sample materials studied to student life (Arends, 2012: 162). By knowing the benefits of use in everyday life, it can bring up to feel the curiosity of students towards learning. Examples workmanship issues contained in problem-based learning (PBL) or in other learning approaches that are realistic. Furthermore, cultivate an attitude of curiosity can be reached in several ways, including: (1) demonstrate things that are unique, new, exciting, shocking or surprising, (2) activities that are challenging students with the knowledge they have (Slavin, 2006: 327).

At a more narrow sense (Kasdhan, at al., 2004: 291) view curiosity as a system of emotional-motivational positively related to exploration activities of the introduction of a thing, the search for the needed information, and setting themselves up for mengekslorasi and get new ideas and opportunity challenges in trying new things. Meanwhile (Ball, 2012: 3) analogize curiosity in science as an impulse that requires understanding of the symptoms that occur in nature.

From the opinions of experts who presented above, it can be concluded that in general curiosity is defined as the desire to obtain more information about the knowledge, skills, or similar natural conditions around new experiences. The desire of curiosity will encourage someone to do a quest for information / knowledge is required. In addition, the finer points of some sense of curiosity outlined above, namely: (1) the desire to obtain some necessary information about an object being studied is the trigger for the attitude of curiosity, (2) the manifestation of the attitude of flavor curious visible from search action / exploration and investigation. The exposure of the aspects and operational indicators curiosity of students that will be used to measure the curiosity of students to mathematics for this study are presented in the table below.

TABLE 4. CURIOSITY ASPECTS AND INDICATORS OF STUDENTS

Aspect	Indicator
Desire to learn	a. Enthusiastic about learning mathematics b. Trying to understand the mathematical concepts c. Happy and diligent study, vigorously, do not get bored with varied tasks.
Investigate	Trying to find a solution difficulty in understanding the math by asking the friends / people who know better, or by reading / studying math book.
Coordinate existing cognitive structure	Using the theory / concept that has been studied previously in understanding new concepts.

E. Development Learning Tool

In planning learning activities, teachers should set up a device that can support the learning process so that it can run properly. The learning tools that will be developed in the study include lesson plan and student activity sheet.

benefits of preparation lesson plan at least serve as a guide to teach or record teachers in the learning process. In addition, the lesson plan will also provide an opportunity for teachers to mentally rehearse prior to the implementation of learning (Posamenteir, at al., 2007: 47). It is very urgent and very beneficial, especially for teachers who are teaching experience is still relatively new to teaching and teachers who try to apply the model / learning approaches that are new.

The use of worksheets students in learning activities greatly help students to cultivate their own ingredients studied or with friends in a form of group discussions. Student worksheet also serves as a learning resource to facilitate learning in groups according to the learning activities developed.

F. Review of Relevan Research

The research is relevant to this study from the aspect of problem based learning to aspects of mathematical reasoning abilities and aspects of the curiosity of students, as follows:

1. Research conducted by Endang Wahyuningsih (2014) in the junior class VIII, entitled "Development of a circle with a learning device problem-based learning approach oriented mathematical reasoning and communication in class VIII SMPN Puring Kebumen". This research resulted in the learning circle with a problem-based approach pemebelajaran oriented mathematical reasoning and communication junior high school students of class VIII. The tests showed that the lesson plan and

worksheets that are developed each valid criteria with very good category. Field trial results showed that the developed lesson plans and worksheets that meet the criteria of a practical and effective. Practicality achieve excellent category based on the evaluation of teachers, both categories based on student responses, and the very good category is based on the observation keterlaksanaan learning. The effectiveness of achieving effective category based mastery learning students. The percentage of the number of students who pass the tests of mathematical reasoning abilities reached 82.82%, the test mathematical communication ability reaches 76.57%, and the learning achievement test reached 79.69%.

2. Research conducted by Mirayanti (2012) on the high school students of class XI in Bima. The study is quasi-experimental research. The population in this study were all high school students in class XI in Bima district in the academic year 2011/2012. Research samples were high school students of class XI each category represent the school well, pretty and less. The study design used is Nonequivalent Control Group Design by using purposive sampling technique. Research results show that there are differences both on the increase in mathematical reasoning ability and the ability of mathematical communication between students who received the study of mathematics by problem-based learning approach and conventional learning at school either category, sufficient and less. In the school category enough, increase the ability of students' mathematical reasoning, either learning using problem-based learning and conventional learning is higher than the category of good schools and less. Improved communication skills students learn mathematical menngunakan problem-based learning in school enough categories, higher than the students in the school category and less good.
3. Research conducted by Tatang Herman at students of SMP Negeri 22 Bandung with a main subject is class VIII B. The title of his research is Problem Based Learning to Enhance Mathematical Reasoning Ability Junior High School Students. This research is the development activities undertaken collaboratively between teachers, students, and faculty by using descriptive qualitative method. The results of these penelitiann visible improvement of mathematical reasoning abilities experienced by students occurs in every cycle. In the first cycle reasoning test results showed the average mean of 7.35 and the second cycle reaches 7.56. Then in the third cycle of learning seem more evolved and is also evidenced by the results of tests of reasoning at the end of the third cycle, which reached an average 7.90.

G. Framework

In the first phase of PBL, students are exposed to the problems that are real that stimulate the curiosity of students. Such problems will raise questions on students, encouraging students reason to hypothesize and speculate. In the process of finding a solution, students need to think logically. Thus, learning by PBL can improve students' mathematical reasoning abilities.

The next phase, students will be guided to plan the inquiry process by forming a group, divide the tasks of investigation, as well as set a specific subtopic-topics to be studied more deeply. So that the investigation can proceed smoothly, the division of tasks for each member of the group must be clear. In this situation, the student will communicate to share role and it is expected to increase their curiosity towards their respective roles in the investigation activities to be undertaken in the next phase.

In the third phase PBL, students are asked to conduct an investigation / discussion groups. At this stage, students can discuss intensively so that they will be asked, answered, criticize, mengevalasi, and to clarify any concepts or mathematical arguments that emerge from the discussions. In this event also allows the development of students' ability to create, refine and explore allegations (conjecture) that solidify their understanding or mathematical concepts being studied, or the mathematical problems are solved. In addition, these activities also allow students to collect and analyze information, conduct investigations, and make conclusions. Thus, the atmosphere of cooperation within the group as described above, can improve communication skills, curiosity and students' mathematical reasoning.

Furthermore, in the fourth phase is the presentation of the work, the students communicate the results of group discussion, either orally or in writing to the teacher and classmates. At this stage, the students rehearsed a lot about how to present their thoughts are kind and courteous to others. Thus, learning by PBL can improve students' mathematical communication skills.

Last phase of the analysis and evaluation of problem-solving process. The core of this activity is to reflect on the thinking of students and the process of investigation or the problem solving process that has been done. Through this phase, various errors will be corrected. Thus, it will improve the ability of mathematical reasoning and mathematics achievement learn some vital lessons.

III. CONCLUSION AND SUGGESTION

PBL is a learning approach that stimulates the power of reason and the attitude of curiosity of students. Moreover, PBL is also a learning approach that is recommended and in accordance with the curriculum of 2013. Each phase in the PBL has a role in enhancing the ability of reasoning and the curiosity of students. Presents problems that will be used in PBL is not easy. The exact problem should include a contextual situation motivate students to complete although not yet know firsthand how that should be done to solve the problem. This does not mean that type of problem to be intractable students, even teachers are expected to predict that siiswa has the potential to solve them. Sometimes PBL can be time consuming long enough if the management class is not managed properly. Therefore, teachers should have a lesson plan carefully, so it is expected to guide and help students exactly how, appropriate and timely.

Teachers as agents of change in the front line of education are expected to implement the PBL approach in teaching mathematics in schools. Thus, it is expected that students have good mathematical reasoning ability and a high curiosity towards mathematics.

ACKNOWLEDGMENT

This paper is part of a research and development tool math learning by problem-based-learning approach to improve mathematical reasoning ability and attitude of curiosity of students. Thanks to Dr. Heri Retnawati on the guidance given in this research and development.

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ME – 13

The Development of Module of Learning Quadrilateral Based on Van Hiele Theories

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Abstract— The aims of this research are to know the process and to develop a teaching and learning module using Van Hiele theories in learning quadrilateral for grade VII students in middle school. The relevant research state that nowadays students are instantly generalizing the concept of geometry without further understanding about the properties of geometry and the ability of proving and reasoning. Whereas, the purpose of learning geometry is to achieve the deductive thinking which is in level 2 informal deduction based on Van Hiele geometry thinking level. The survey result state that only 10% of students reached level 2 informal deduction, 56,6% students reached level 1 analysis and the rest of students are still in level 0 visualization. The book of reference for learning quadrilateral or module of learning is not written to reach level 2. The book is only consist of definition and properties of quadrilateral without further learning experience for increasing deductive thinking skill. In order to solve this problem, this research develops a module which is written based on phase of learning geometry. The purpose is to make students think and learn quadrilateral in higher geometry thinking level. The quality of this module is assessed based on contains, appearances, graphics, and language. The method of research is research and development with modification of Borg and Gall and Plump method. The module is verified through trial test in a class of students grade VII in order to get data of validity, effectivity, and practically. The result of this research is a module which is consist of two sections. Section one consist of activities in order to increase level 0 to level 1. Section two consist of activities in order to increase level 1 to level 2. Each section is designed as five phase of learning geometry by Van Hiele.

Keywords: Van Hiele, Quadrilateral, Research and Development, Modul of Learning

I. BACKGROUND

Even though learning geometry seems easy because it studies about shapes which is not too abstract, but students face difficulties and has a misconception about geometry (NCTM in Biber, 2013)[1]. Fujita & Jones (2007)[8] indicate that students face difficulties because they do not have enough understanding about the concepts so they overgeneralize the concepts. For example, in learning quadrilateral, mostly student memorize the properties rather than understanding the concept and link the implication of each quadrilateral's definition (Okazaki & Fujita, 2007[12]). This condition shows that students have not reach the goal of learning geometry which is having skills in reasoning and proving through deduction thinking process (Clements & Battista, 1992[3]).

Based on Van Hiele level of thinking geometry, students in junior high schools can be divided into three level of thinking: Level 0 Visualization, Level 1 Analysis, and Level 2 Informal Deduction (Crowley, 1987[5]). Pre-survey is done at grade 7 students at SMP N 1 Selogiri. The results show that only 10% students reach level 2 Informal Deduction, 56 % students reach level 1 Analysis, and the rest of students stay at level 0 Visualization. Students face difficulties in classification of quadrilateral which is the indicator of reaching level 2 informal deduction. Based on direct interview when students doing the survey, students face difficulties to relate each quadrilateral because previously they learn class of quadrilateral separately.

In theories of Van Hiele geometry thinking level, the level of geometry thinking can be increased using instruction. The instruction is given based on Five Phase of Learning Geometry (Erez & Yerushalmy, 2006[7]). This phase of learning is designed to help teacher design a teaching and learning activities in order to increase students' thinking. In this case, this phase can be designed to help all students reach level 1 Analysis. After that, this phase also can be done to help students reach level 2 Informal Deduction. Other than the design of activities, this phase of learning needs teacher's intervention in facilitating the learning activities. It is happened because the increasing of level of thinking cannot be done naturally, meaning that teaching and learning geometry need to be done using activities designed based on five phase of learning geometry and teacher facilitation (Burger, 1986[2]).

This 5 phase of learning geometry is arranged systematically as inquiry phase, free orientation phase, explication phase, direct orientation, and integration phase. The teaching and learning activities is arranged based on these phase and should be arranged systematically. In other hand, students' ability of learning is variety. It means that the speed of learning will be different. Therefore, these phase of learning need to be written in module, so students are able to study individually based on their level of thinking (Daryanto, 2002[6]). In fact, module which contain this phase of level is hard to find in Indonesia. Pre-survey shows that commonly the quadrilateral topic is written with order such as definition of quadrilateral, properties of quadrilateral, area and perimeter of quadrilateral, and evaluation. Teacher also follow the order written in book of reference. Commonly, the book of reference does not provide activities to facilitate students to think deductively.

In order to solve problems of limitation book which provide the five phase of learning geometry and urgency of increasing students' geometry thinking level. This research develops a module of learning quadrilateral based on five phase of learning geometry in order to increase the students' geometry thinking level.

Hence, the research question for this research is how is the process and result of development of a module of learning quadrilateral based on Van Hiele theories which is valid? The purpose of this research are to explain the process of develop and produce a valid module of learning quadrilateral based on Van Hiele theories.

II. LITERATURE REVIEW

Van Hiele model in geometry consist of exist of level, properties of level, and movement from one to another level. Exist of level consist of geometry thinking level of a students. It is consist of five level (Burger, 1986).

1) *Level 0 is called visualization level.* Students in this level are able to give name for selected quadrilateral but they are not able to give correct reason. They likely say "because it looks a like". Students also able to draw a quadrilateral based on its name. The drawing is not detil means there is no sign of similar sides or angles or others.

2) *Level 1 is called analysis level.* Students in this level are able to link the figure of quadrilateral with its properties. They are able to state the properties or analyze quadrilateral based on properties given. But, students in this level could not show the relationship of quadrilateral.

3) *Level 2 is called Informal Deduction level.* Students in this level are able to show how one class of quadrilateral has relation to others class of quadrilateral. Students are able to give reason based on properties of quadrilateral. But, students could not give a reason formally and systematically as proofing.

4) *Level 3 is called Deduction level.* Students in this level are able to proof the geometry statement using postulate, axioma, and proof systematically. This level of thinking is commonly shown by college students or university students.

5) *Level 4 is called rigor level.* Person in this level are expert in proofing deductively the axioma, prostulate in geometry. They are able to work on both Euclidean and Non-euclidean geometry.

Since, students in secondary level is asked to have ability in reasoning, so the level of thinking of students in sedondary is vary from level 0 to level 2. In properties of level is shown that each level is fix, meaning that students cannot naturally jump from one to another level. In order to move from one to another level, teh teaching and learning geometry should be consist of The Five Phase of Learning Geometry (Burger 1986, Clements & Battista, 1992).

1) *Inquiry.* This phase is consist of the activity in order to build students' attention towards the field of study that will be taught. Commonly, the activity of this phase is introducing the field of study or the application of the study.

2) *Free Orientation.* This phase will give experience for students to directly involve in knowing the field study that being taught. The activity of this phase are commonly design as grouping a figures, draw a figures, and others.

3) *Explicitation.* In this phase, students are ask to state their understanding towards the field study that being taught. Students experience how to link their prior knowledge to the new knowledge they got. Activity in this level is commonly design as identify properties of figures.

4) *Direct Orientation.* In this phase students get more complex problems in order to apply students' new knowledge.

5) Integration. This phase is designed to summarize all of knowledge that students learnt during the lesson. Activity of this phase is design as making summary of the lesson or making mind mapping of classification of the field study,

III. METHODS

The subject of the test of this research is students of SMP N 1 Selogiri. Subjects are randomly chosen from grade 7. Validator are purposively chosen from mathematics expert, mathematics practitioner, lecturer, and teacher.

This research use research and development method. Research and development method is a method of research which is used to produce a specific product whether software or hardware (Sugiyono, 2012[14]). This research modify the Plomp and Borg & Gall (in Sukmadinata, 2007[15]) model of research and development. The following are research procedure of this research: 1) Initial Investigation: In this stage, researcher do a literature review about Van Hiele theories, analyze students' level of thinking geometry, and analyze the book of reference which is used by students and teacher. 2) Design: In this stage, the plan of module is designed based on literature review result and analysis result from initial investigation. 3) Realization: In this stage, the researcher make realization of module based on theories and analysis into draft 1 module of learning quadrilateral. The systematic of writting module refer to Daryanto (2002). 4) Test, Evaluation, and Revision: In this stage, the draft 1 module is reviewed by validator of media experts and concept experts.

This research need a data of assessment result towards module which is coming from validator in education experts, mathematics experts, and practitioner and students' comments after using this module as learning media. The data contains a content validation of module of learning.

The research instrument of this research is a validation sheet and students' comments. Students' comments is used to collect data of students's comments towards module. Validation sheet is designed as validator reference in assessing the module of learning quadrilateral based on Van Hiele theories. The components in assessing module are consist of (BNSP, 2007[16]) as: 1) Content aspect: Content aspect consist of validity for compatiblity of competence standard, accurate of contents, up to date of contents, compatibility of Van Hiele theories, compatiility of module's components, and effort of increasing geometry thinking level. 2) Presentation aspect: Presentation aspect contains of presentation technique, presentation of learning, and completeness of presentation based on module's components. 3) Language aspect: Language aspect contains of compatibility of students' development mental level, compatibility with Bahasa Indonesia, and systematically of thinking plot. 4) Graphics aspect: Graphics aspect consist of book size, cover design, content design, ilustration, compatibility of paper, compatibility of cover paper.

The data collected is analyzed using content validity analysis. All data coming from validators of content validator and media validity are compared and is analyze in order to do revisions for the module. Data of students' comments is analyze as qualitative data. Data collecting will stop until validator state that the module is valid and ready to use. Revisions are made based on validators' assessment and students' comments.

IV. RESULT

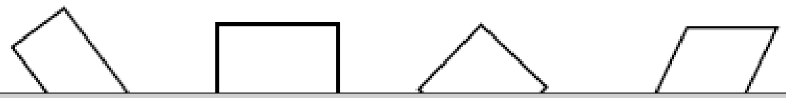
Based on validity contents from validator and students' test, the process and product of this research as follow:

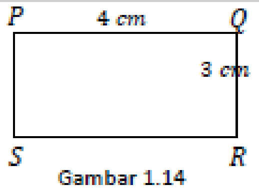
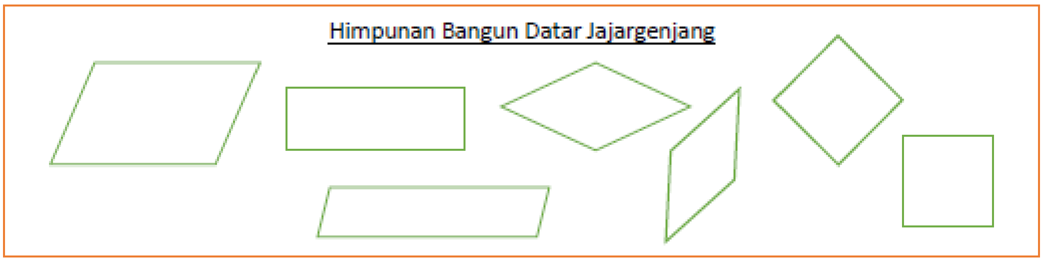
A. Content Validity

Three validator of content expert validate the module based on BNSP's assessment of module. The corrections for module is given as follow:

1) Module 1: This section contains of concept of definition and properties of quadrilateral. In this section, students learn about six class of quadrilateral including paralelogram, rectangle, square, rhombus, kite, and trapezoid. Activity of inquiry phase is designed to give a sufficient information for students about what quadrilateral is. The activity chosen is recognizing the quadrilateral shapes in real life. By recognize the quadrilateral shape in real life, students are expected to build their knowing about classes of quadrilateral that will be material of discussion at class. The revision is given to the instruction because the instruction is not clear and easy to understand. Validator suggest to give instruction one by one to make it easy to be understand. Other than that there is no link to classes of quadrilateral. Activity of free orientation is designed to give opportunities for students to getting involve in knowing the topic discussion. The activity of this phase is grouping quadrilateral into six classes of quadrilateral. Students are expected to be able to grouping the quadrilateral based on its shapes. Revision for this phase is given to the instruction. The instruction is given one by one to make it clear and easy to understand. The revision is made as table 1. Activity of explication phase is designed to encourage students to be able to explain their opinion about topic discussion. The activity of this phase is identify the properties of each class of quadrilateral at section "Tugas". Revision is given to the illustration of the properties in order to help students with visualization level. The instruction of material also revised in order to be easily understand. The revision is made as table 1. Activity of direct orientation is designed to give opportunities for students to work on more complex task. In this phase, the activity is to identify the properties of certain quadrilateral problem. The detail is made as table 1. Activity of integration phase is designed to summarize the topic of discussion. The activity is making a definition for each class of quadrilateral. As addition, given shapes of set of certain quadrilateral in order to help students with visualization level. The detail is made as table 1. As addition for integration phase, the module provide a summary of the properties of quadrilateral. Validators suggest to add more accurate properties and accurate definition of quadrilateral. Other than that, validators suggest to add shapes with specific mark to help students in visualization level.

TABEL 1. ACTIVITY OF MODUL 1

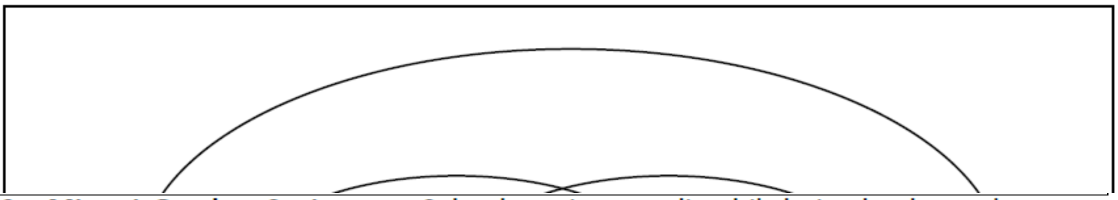
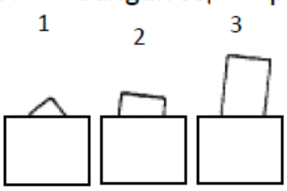
<table>
<tr><th>Phase</th><th>Activity</th></tr>
<tr><td>Free Orientation</td><td>
KEGIATAN 1.1: MENGELOMPOKKAN SEGIEMPAT
Pada kegiatan sebelumnya, kamu menemukan beberapa jenis segiempat yaitu persegi panjang, persegi, jajargenjang, belah ketupat, layang-layang, dan trapesium.
Pada kegiatan dibawah ini kamu akan mengelompokkan keenam jenis bangun segiempat. Ikutilah petunjuk berikut!
1. Potonglah bangun-bangun segiempat dibawah ini.
2. Kelompokkan menjadi 6 jenis segiempat.
3. Tempelkan pada Tabel 3, serta beri nama jenis segiempatnya.

</td></tr>
<tr><td>Explicitation</td><td>
TUGAS 1.1 : Identifikasi sifat-sifat persegi panjang dengan tabel berikut ini!
Tabel 5. Sifat-sifat Persegi Panjang
<table>
<tr><th>Gambar</th><th>Sifat</th><th>(coret pernyataan yang salah)</th></tr>
<tr><td></td><td>Panjang sisi yang berhadapan.</td><td>Sama/tidak sama panjang.</td></tr>
<tr><td></td><td>Kedudukan sisi yang berdekatan.</td><td>Sejajar/berpotongan tegak lurus/ berpotongan tidak tegak lurus.</td></tr>
</table>
</td></tr>
</table>

Direct Orientation	**SOAL 1.1 : Jawablah pertanyaan berikut!**  Gambar di samping adalah persegi panjang PQRS. 1. Sebutkan panjang dua pasang sisi persegi panjang PQRS yang sama panjang!
Integration	**DISKUSI 1.3 : Jawablah pertanyaan-pertanyaan diskusi berikut!**  1. "Jajargenjang adalah segiempat yang panjang sisi berhadapannya sama". Apakah pernyataan di atas cukup untuk menggambarkan jajargenjang? Jelaskan!

2) Module 2: Learning activity 2 contains a discussion about classificatin of quadrilateral. Through this activity, students are expected to reach level 2 informal deduction thinking level. Activity of inquiry phase is knowing about changes of sides or angles which imply a class of quadrilateral become another class of quadrilateral. Students are expected to aware about the relationship of each quadrilateral which is the topic discussion of this section. Validators suggest a revision to the instruction Activity of free orientation phase is experiment of changing sides or angles. Students are expected to experience the changing of sides or angle so they recognized the relationship. The detail is made as table 2. Activity of explication phase is making a Venn diagram of relationship of quadrilateral. Students are expected to show their opinion of quadrilateral relationship that has been discussed. Validators suggest to put a picture of the Venn diagram in order to make student easily understand the instruction. The revision is made as table 2. Activity of direct orientation is answering more complex problem about relationship of quadrilateral. Validators suggest to revise the instruction. The revision is made as table 2. Activity of integration is classify the quadrilateral. Students are expected to use all their knowledge about topic discussion to summarize the classification of quadrilateral. The activity is made as table 2.

TABEL 2. ACTIVITY OF MODUL 2

Phase	Activity

Free Orientation	**Eksperimen** **Lakukan eksperimen pada bangun segiempat dengan mengubah ukuran sisi atau sudutnya.** **Ikutilah petunjuk berikut!** 1. Buatlah **sebuah segiempat** (pilih persegi panjang, jajargenjang, atau belah ketupat)!
Explicitation	**TUGAS 2.1** **Buatlah diagram Venn yang menggambarkan hubungan antara himpunan bangun persegi panjang, persegi, jajargenjang, dan belah ketupat!** 
Direct Orientation	2. **Misteri Gambar Segiempat.** Sebuah segiempat diambil dari sebuah amplop secara perlahan-lahan seperti gambar berikut. Gambar diambil dengan cara menarik atau merotasi bangun segiempat. Tebaklah kemungkinan gambar yang akan muncul! a.  Gambar 2.7 Kemungkinan bangun apa yang akan muncul? ________
Integration	**DISKUSI 2.1: Berdasarkan Diagram Venn pada Tugas 2.1, jawablah pertanyaan berikut!** (Sumber: Fuys, David., Geddes., & Tischler, Rosamond. 1988. The Van Hiele Model of Thinking in Geometry Am Adolescents) 1. Apakah persegi merupakan anggota kelompok persegi panjang?________________ Mengapa?____ 2. Apakah persegi panjang merupakan anggota kelompok kelompok persegi?________ Mengapa?____

B. *Media Validity*

1) *Cover:* Cover is designed to illustrate the topic discussed in the module. Validators suggest to make a specific illustration according to the classification of quadrilateral. The illustration must contain the classification of quadrilateral because that is the uniqueness of this module. Revision is made as figure 1.

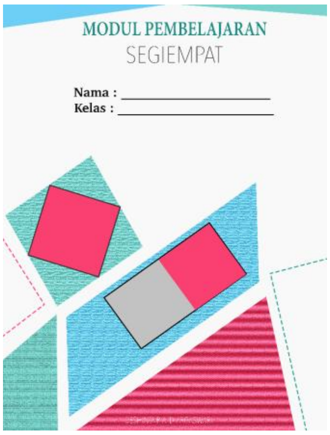


FIGURE 1. MODULE COVER

2) Clipart: Cliparts is used to gain students attention to the module. Validator suggest to use a pictures of application of quadrilateral in real life rather than using clipart. It is used to gain more attention and avoid students' boredom. The revision is made as tabel 3.

TABEL 3.CLIPART

Section	Picture
Clipart before revision	
Clipart after revision	 

C. Students' Test

The module is tested to 11 subjects coming from grade 7 students using random sampling. The purpose of this test is to see how well this module help students to learn quadrilateral. Some revision is made due to students' comments after using the module as learning media. All of students agree that the module help students to learn quadrilateral. For module 1, 63,6 % of students like to work on quadrilateral introduction on inquiry phase, 18,1 % students likes identification of quadrilateral's properties, 9,09 % students like matching pair, and 9,09% students like others. Students who like quadrilateral intoduction state that they like this activity because they enjoy to grouping the quadrilateral and they are able to directly learn how to distinguish the quadrilateral into six groups of quadrilateral. Students who like identify the quadrilateral's property state that they like this activity because they are able to understand easily the properties of quadrilateral.

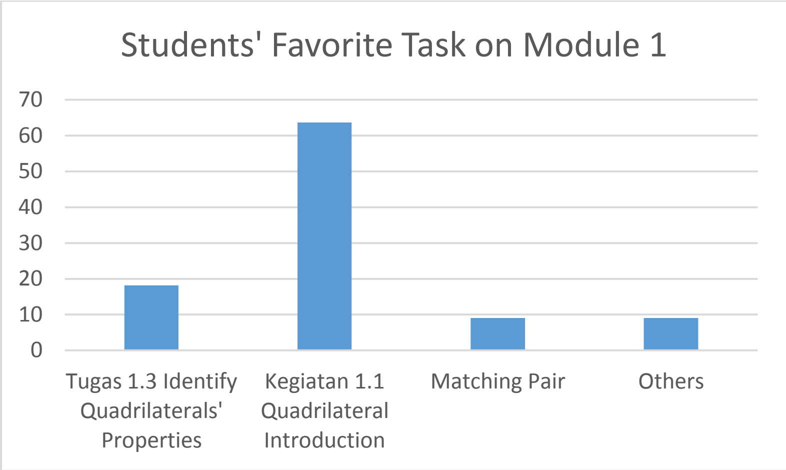


FIGURE 2. STUDENTS' FAVORITE TASK ON MODULE 1

For module 2, 45,5 % students like to work on experiment task, 18,2 % students like Venn Diagram, 18,2 % students like Soal 2.1, and 18,2% students like others. Students who like experiment task state that they like this activity because they learn something new about quadrilateral. They just know that there are relationship of quadrilateral by changing the angles or the sides. Venn Diagram also being liked by students because students can easily understand the relationship of quadrilateral. Soal 2.1 is impressed students as students state that it was fun answering the problem.

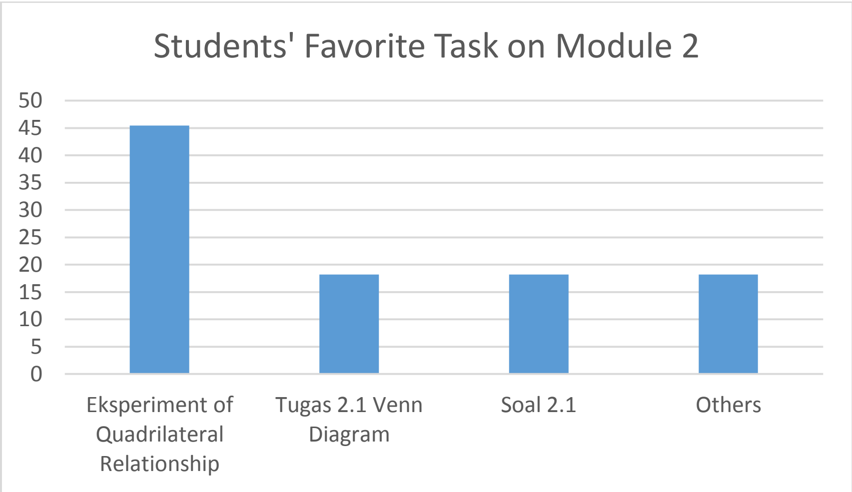


FIGURE 3. STUDENTS' FAVORITE TASK ON MODULE 2

Students face some difficulties to work on module. 9,09% students difficult to work on "Diskusi" where students are ask to summarize the minimum properties of quadrilateral. 18,2 % students face difficulties to understand the definition of parallelogram.

V. DISCUSSION

Through this result, it shows how to implement The Five Phase of Learning Geometry by Van Hiele step by step. For Module 1 which contain of the definition and properties of quadrilateral, the inquiry phase supposed to stimulus students to know the application of quadrilateral in the real life. As addition to gain students interest, module should use the variety of picture of application of quadrilateral. Free orientation phase can be given by grouping the quadrilateral because it helps students to distinguish the classes of quadrilateral. 63,6% students like to work on this activity because students experience by them self how to distinguish the quadrilateral and it is easy to use by the students in visualization level. Because it is the beginning of module, module should be able to help students in the lowest level. Explicitation phase can be given by identify the quadrilateral properties. Based on test result, it can be seen that the format of picture and table of this activity helps students easily understand the properties of each quadrilateral. But students face difficulties on parallelogram topic. It is happened because the definition used in this module is different from the previous one. Naturally, students get confused at the first time, but then by using this definition in the following activity, students can build their undertanding deeply about parallelogram. The direct orientation phase is given by working on complex problem. Last, integration phase can be given by discussion of the minimum properties. 9,09% students state that this activity is quite difficult for them because they need to understand the minimum properties. The next revision of module 1 is given to integration phase consider to the level of difficulties for students.

For module 2 which contains of the relationship of quadrilateral, the inquiry phase is given by build the students' awareness of the relationship of quadrilateral. After that, the free orientation phase is given by experiment to make specific quadrilateral become another class of quadrilateral. Students show enthusiasm in this activity by giving positive comments because they learn something new about quadrilateral. This activity success to give students an experience by themselves in proving the relationship of quadrilateral. The next phase is given by asking students to make a Venn Diagram of the relationship of quadrilateral. Students give positive comments because they feel easily understand the relationship through Venn Diagram. The direct orientation phase is given by working on problems. Mostly problems are posted to gain students' ability in reasoning. On problem quadrilateral mystery, students state that it was fun to guess the quadrilateral. Last, the integration phase is given by asking the relationship. In this phase, students are ask to proving and reasoning by the definition and properties of quadrilateral.

VI. SUMMARY

The process of making the module is summarize as: 1) Review Van Hiele theories especially The Five Phase of Learning and review the topic quadrilateral, 2) Design the activities and questions, 3) Write the draft 1 Module, 4) Test to students and test to validators, 5) Revise based on validators and students' feedback. The module is assessed based on its contents validity of validators. The valid module consist of activities based on the five phase of learning geometry. The valid module consist of: 1) Be familiar with quadrilateral in real life as inquiry phase, 2) Grouping quadrilateral as free orientation phase, 3) Identify quadrilateral's properties as explicitation phase, 4) Solving problem as direct orientation phase, and 5) Summarize the definition of quadrilateral as integration phase. The suggestion for futher research is to consider the integration phase. Some students face difficulties when they need to express their ideas in writting. The module design might included an activity as pre-activity before activity which ask students to write their ideas or opinion.

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ME – 14

The Role of Productive Struggle to Enhance Learning Mathematics with Understanding

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Abstract— Struggle is a natural part of the learning process that refers to a student's intellectual effort to expand their understanding of the mathematical concepts that challenge but fall because of student's capabilities. This paper discuss about the classification of student's struggle and the teacher responses, the role of productive struggle in learning mathematics with understanding, and strategies to supporting productive struggle. Productive struggles are identified as an important component of effective mathematics teaching and learning, implying that good teaching involves placing students in problem solving situations where they would have difficulty and frustration experience that could serve as a learning opportunity. Student's effort to learn mathematics, figure something out that is not immediately obvious can help students in their thoughts and play an important role in deepening the student's understanding. Teachers can give appropriate guidance and support to maintain the mathematics understanding and opportunities to think more deeply about mathematical concepts. When students struggle, there are consequences of "incorrect" answers. It is not seen as failures but rather opportunities to explore, grow, and learn serve better support and motivate students to persist. Teaching that uses productive struggle leads to long-term benefits, with students more able to apply their learning to new problem situations. Mathematics teaching using student's struggles can be good opportunities to deepening their understanding of mathematics so that it can be effective. This study suggests the productive role student struggle can play in supporting student learning with understanding.

Keywords: *productive struggle, learning process, deep understanding*

I. INTRODUCTION

Student's struggle in learning mathematics is often seen in a negative light and viewed as a problem or learning difficulty [1]. Sometimes, the cause of it will be attempted to remove by diagnosis and remediation [2]. There is a negative belief that struggling with a mathematical task is not viewed as an opportunity to learn but as a weakness [3]. It would be hard to see that student's struggle in mathematics could be viewed as positive thing and as a learning opportunity.

Recently, National Council of Teachers of Mathematics (NCTM) released policy document, Principles to Actions. It notes that supporting productive struggle in learning mathematics is one of the eight important teaching practices [4]. Struggle refers to student's effort to make sense mathematics, find something out that is not immediately obvious. It is not used to refer needless frustration levels of challenge created by difficult problems [1].

Struggle is essential to intellectual growth has a long history. Dewey referred to the process of engaging students in some confusion or doubt as essential for building deep understanding. In the other hand, Piaget also thinks that student's struggle as a process of restructuring their disequilibrium towards new understanding [2]. Prior study by Hiebert and Grouws suggest that struggle is a necessary component of learning mathematics with understanding [1]. Warshauer also suggests that productive struggle can support doing mathematics and its implications on student learning with understanding [2]. Teachers and instructional designers also can integrate student struggle into tasks and instructional practices rather than avoid or prevent it. Productive struggles are identified as an important component of effective mathematics teaching and learning, implying that good teaching involves placing students in problem solving situations where they would have difficulty and frustration experience that could serve as a learning opportunity [5]. This paper tries to discuss about the role of productive struggle to enhance learning mathematics with understanding.

II. Discussion

A. Productive Struggle

Struggle is a natural part of the learning process. It refers to that a student's intellectual effort to expand their understanding of the mathematical concepts that challenge but fall because of student's capabilities [1]. Student's struggle is an opportunity for investigating more deeply into understanding the mathematical problems and the relationships among mathematical ideas, instead of simply seeking correct solutions [4]. Thus, struggle is a student's intellectual effort to expand their understanding of the mathematical concept by investigating more deeply the mathematical problems and *the* relationship among mathematical ideas, instead of simply seeking solution of a challenge problem but they fall because of their capabilities. There are some types of struggle [2][6].

1) *Get started:* Students feel confuse about what the task asked them to do ("I kind of understand it…but I'm a little confused"). Some students may even proclaim they did not remember doing problems of this type though it appeared vaguely familiar to them ("I have absolutely no idea….I don't remember that far"). Then, they call for help ("I need help") and gesture uncertainty and resignation (looks, thinks, sits back and then says, "I don't know") or show no work on their paper.

2) *Carry out a process:* Some students get difficult to carry out the procedure and the demonstrated or voiced some plan for achieving the goal of the task but encountered an impasse. These impasses tended to revolve around an inability to implement a process such as solving the problem.

3) *Uncertainty in explanation and sense making*: Students are uncertainty in explaining or sharing their work in small groups or with the whole class. In order for students to complete each task, they are expected to explain their work and solutions in writing and in many examples to each other or to the class. Students often struggled to verbalize their thinking and give reasons for their strategies even if their answer appears correct.

4) *Express misconception and errors*: Struggle is involved the students' misconceptions appeared to be instances when deep-seated mistaken ideas were used as the basis for solving problems rather than student's confusion or possible error due to carelessness.

Teacher must support student's struggle, so it is become positive endeavor and not full of difficulties and frustration [2]. Teacher needs to be careful to select the best responses of the struggle. Teacher's responses to student's struggle generally divided into four types [2][6].

1) *Telling*: In a telling responses, teachers often provides sufficient information for the students to overcome the struggle, suggest a new approach or strategy, correct an error, evaluate students work, related to simpler problem and decrease process time.

2) *Directed guidance*: Directed guidance involves redirecting student thinking toward the teacher's thinking, narrowed down possibilities for action, directing an action, breaking down the problems into smaller parts or altered problems to an analogous one such as from an algebraic to numerical ones. It is done by asking open-ended questions, breaking down the problem into smaller parts, and narrowing down what the student might try next.

3) *Probing guidance*: Probing guidance puts the struggle back into the student's lap. Teacher offers ideas based on the student's thinking, asks for an explanation that might surface an error, or asks for reasons and justifications. Then, teacher must seek explanation that could get at an error or misconception and ask for written work of student's thinking.

4) *Affordance*: Affordance provides an opportunity for students to continue to engage in thinking about the problem and build on their ideas with little help from the teacher. Teacher is explicit in encouraging students to continue their effort in their task. The characteristics of these types of respond are ask for detailed explanation, build on students thinking, press for justification, sense making with group or individually, and afford time for students to work.

All of these approaches are useful as long as the level of cognitive demand remains high, and student thinking is supported [3]. When students show effort to solving the confusing problems or making sense of challenging ideas, they engage productive struggle process [7]. Productive struggle is fostered through what psychologists have termed desirable difficulties; challenges that compel the learner to repeatedly retrieve information over time, thereby strengthening long-term memory for flexible transfer of the information to new contexts later [7]. Productive struggle, similar with to other executive function like cognitive skills that help the brain organize and act on information, is supported by a developmental progression in thinking and learning [3]. It is a core component of effective mathematics teaching and learning, implying that good teaching involves putting students in problem-solving situations where they will feel the difficulties and frustrations that could serve as learning opportunities [5]. Students can experience productive struggle when given a task slightly beyond their abilities. Some factors influence productive struggle, that is:

1) Mathematical self-image: Mathematical self-image is related student's perception about their mathematical ability. Students often think that mathematical ability is something that some students are skilled at rather that a behavior that everyone can develop [3]. Because of it, motivation is needed. Motivation for productive struggle requires a growth mindset. It is an understanding that success is a result of effort more than of raw ability. It makes students want to new challenges, and enthusiastic rather than be afraid about learning. Students who believe that their ability levels are fixed are less motivated to engage in productive struggle because they afraid of failure, resist the risks, and worry about the judgments of others, thwarting their own learning [7].

2) Student's disposition with challenging mathematical task: Student's disposition depends on whether they (1) find the task interesting, (2) believe that they know enough mathematics to be able to solve it, and (3) believe that solving it is worth the effort. Student's belief that effort is more important than innate ability is the main factor. In order to persevere, one needs to view the struggle that may to be a part of problem solving as an opportunity to learn. Motivation enables a solver to see struggle as a natural part of the learning process, and to see that confronting and working through struggle can ultimately be helpful [5].

3) Support and feedback: Effective feedback makes clear about what the goal is, what progress they are making toward that goal, and what they need to do next to make better progress. The durability of students' motivation to do in struggling to achieve a goal is mediated by the quality of the teacher-student relationship and the scaffolding provided through feedback. Correcting students' errors, effective feedback guides students to develop better strategies for processing and understanding the material so that they get mastery, confidence, and motivation to continue to support effort in productive struggle [6].

Struggle is not productive when students become frustrated because the goal is unclear or far out of reach, they do not feel safe to fail, or they do not receive adequate, appropriate support. Struggle can be destructive, and teachers need to intervene after finding that students are not making any progress and feeling that their efforts are pointless [6]. Struggle is productive if student's can maintain the initial goals and cognitive demand of the task, support their thinking by acknowledging effort and mathematical understanding, and move forward in solving the task through their actions [2].

B. The Role of Productive Struggle in Learning Mathematics with Understanding

Struggle is a necessary component of learning mathematics with understanding [1]. Understanding is defined as the mental connections among mathematical facts, ideas, and procedures, and then struggling is viewed as a process that reconfigures these things [1]. Relationships among facts, ideas, and procedures are reformed when new information cannot easily be assimilated or when the old relationships are found to be inadequate to make sense of a new problem [9].

Understanding is crucial because learning with understanding can be used flexibly, adapted to new situations, and used to learn new things. It is the most useful things to know in a changing and unpredictable world. Students who lack understanding and must resort to memorizing are likely to feel little sense of satisfaction and are likely to withdraw from learning. Understanding gives student confidence and engagement; not understanding leads to disillusionment and disengagement [11].

Understanding is participating in a community of people who are becoming expert at doing and making sense of mathematics, then struggling is vital because it can be an essential aspect of personal meaning making within the community [14]. Understanding is also important because it is one of the most intellectually satisfying experiences, and, on the other hand, not understanding is one of the most frustrating and ultimately defeating experiences. Learning mathematics with understanding has increasingly received attention from mathematics educators and psychologists and has progressively been elevated to one of the most important goals of the mathematical education of all students [10].

Students who are given opportunities to understand, from the beginning, and who work to develop understanding are likely to experience the kind of internal rewards that keep them engaged. Student's effort to learn mathematics, find something out that is not immediately obvious can help students in their thoughts and play an important role in deepening the student's understanding. In summary, struggling with important mathematics is implicated in both definitions of understanding by identifying the common processes hypothesized to develop understanding. Mathematics teaching using student's struggles can be good opportunities to deepening their understanding of mathematics so that it can be effective.

C. Strategies to Supporting Productive Struggle

To support productive learning, students must realize that they have an ability of doing well in mathematics with their effort and perseverance in reasoning, sense making, and problem solving. Teachers provide support and guidance for students, individually and collectively, to work through uncertainties as they struggle with representing a mathematical relationship, explaining and justifying their reasoning, or finding a solution strategy for a mathematical problem. The table below summarizes teacher and student actions supporting struggle as a natural aspect of learning in the mathematics classroom [4].

TABEL 1. SUMMARIZES TEACHER AND STUDENT ACTIONS SUPPORTING STRUGGLE

What are teachers doing?	*What are students doing?*
• Ancipating what students might struggle with during a lesson and being prepared to support them productively through the struggle • Giving students time to struggle with tasks, and asking questions that scaffold student's thinking without stepping in to do the work for them • Helping students realize that confusion and error are a natural part of learning, by facilitating discussions on mistakes, misconceptions, and struggles. • Praising students for their efforts in making sense of mathematical ideas and perseverance in reasoning through problems.	• Struggling at times with mathematics tasks but knowing that breakthroughs often emerge from confusion and struggle. • Asking questions that are related to the sources of the struggle and will help them make progress in understanding and solving tasks. • Persevering in solving problems and realizing that is acceptable to say, "I don't know how to proceed here," but it is not acceptable to give up. • Helping one another without telling their classmates what the answer is or how to solve the problem.

Teacher and student must cooperate to support struggle in mathematics classroom. Teachers need to select tasks carefully that require students to struggle and provide the support that students need without giving students too much help. Students need sufficient time, not only to solve difficult mathematical problems, but also to develop genuine curiosity and durability [3]. They also influence how students perceive and approach struggle in the mathematics classroom. They can give appropriate guidance and support to maintain the mathematics understanding and opportunities to think more deeply about mathematical concepts. In the below, there are some strategy to support student struggle and make it productive [3].

- Set goals at the beginning of the lesson and keep track of student progress during the lesson.
- Set problems in a familiar setting whenever possible, such as a sport or a familiar everyday task.
- Support students by providing appropriate tasks, tools, and representations.
- Group students heterogeneously, which helps struggling students.
- Establish high mathematical expectations (i.e., doing mathematics requires effort).
- Use good questioning techniques, such as asking students to explain how they solved a problem and why a strategy works or ask them to describe another way to solve the same problem.
- Provide time for group reflection during problem-solving activities. This can help students recognize unproductive strategies.
- Compare student outcomes at the end of the lesson to your original goals.

Supporting from teacher, in one side can enhance and in other instances diminish the level of student learning. It depends on the circumstances, including the goals of the task, the student's prior knowledge, and the student's willingness to attempt to do the problem. Teachers can incorporate into their practice explicit reminders to students that struggling to make sense of mathematics is an important and natural part of learning. Rather than avoiding this phenomenon, teachers can integrate struggle as part of doing mathematics by acknowledging students' consternation, encouraging perseverance, asking questions, and offering time to work through problems. Table 3 shows the outlines teaching strategies that remind students of the positive aspects of struggle and student actions that indicate productive engagement [6].

TABEL 2. STRATEGIES AND INDICATIONS OF PRODUCTIVE STRUGGLE

	Teaching Strategies	*Student indicators of a Productive Struggle*
Question	Teacher asks question that help students focus on their thinking and identify the source of their struggle, then encourage students to build on their thinking or look at other ways to approach the problem.	Students ask questions to identify the source of their struggle, write down their ideas, clarify ideas with others, and consider alternative strategies or representations to address their struggle.
Encourage	Teacher encourages students to reflect on their work and support student struggle in their effort and not just in getting the correct answers.	Students use their effort to solve problems and try to make sense of their work, not only satisfied with a correct answer or that they perceive themselves as smart or not.
Give time	Teacher gives time and support for students to manage their struggle through adversity and failure by not stepping in too soon or too much, thereby taking the intellectual work away from the students	Students use their time to develop and follow through on their strategies, evaluate their progress, and understand what they can do and what still remains to be done.
Acknowledge	Teacher acknowledges that struggle is an important part of learning and doing mathematics	Students persist in their work to make sense of and to solve their problem and not give up or get discouraged easily.

When students appear confused, unable to make sense of an answer, or reach an impasse in working on their task [6]. This is not obstacle in learning but it is an opportunity for develop student's understanding of mathematics. When students struggle, there are consequences of "incorrect" answers. It is not seen as failures but rather opportunities to explore, grow, and learn serve better support and motivate students to persist. One of cognitive approach to learning mathematics with understanding is using student's error or incorrect answer as sources of information about their understanding [9]. By incorporating instructional approaches that acknowledge student's struggles and effectively support, guide, and feedback the student's thinking toward a productive resolution, student given opportunities to strengthen their disposition toward challenging tasks and they will persist through their struggle to make sense of and understand important mathematics.

III. CONCLUSION

Struggle is a student's intellectual effort to expand their understanding of the mathematical concept by investigating more deeply the mathematical problems and the relationship among mathematical ideas, instead of simply seeking solution of a challenge problem but they fall because of their capabilities. There are some type of struggles, i.e., get started, carry out a process, uncertainty in explanation and sense making, and express misconception and errors. Teacher's responses to student's struggle generally divided into four types, i.e., telling, directed guidance, probing guidance, and affordance. Struggling to make sense of mathematics is a necessary component of learning mathematics with understanding. Understanding is the mental connections among mathematical facts, ideas, and procedures and learning with understanding can be used flexibly, adapted to new situations, and used to learn new things. Students who are given opportunities to understand, from the beginning, and who work to develop understanding are likely to experience the kind of internal rewards that keep them engaged. Teachers provide support and guidance for students, individually and collectively, to work through uncertainties as they struggle with representing a mathematical relationship, explaining and justifying their reasoning, or finding a solution strategy for a mathematical problem. Teachers can incorporate into their practice explicit reminders to students that struggling to make sense of mathematics is an important and natural part of learning. Rather than avoiding this phenomenon, teachers can integrate struggle as part of doing mathematics by acknowledging students' consternation, encouraging perseverance, asking questions, and offering time to work through problems. Teaching that uses productive struggle leads to long-term benefits, with students more able to apply their learning to new problem situations. Mathematics teaching using student's struggles can be good opportunities to deepening their understanding of mathematics so that it can be effective.

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ME – 15

Didactical Design Research of Mathematical Communication about Concept of Cuboid Volume in Elementary School

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Abstract- The research based on learning obstacle in preliminary research about mathematical communication for concept of cuboid volume which must be understood student. These concepts are taught in the fifth grade. The research purposes to be achieved is of development of learning design of cuboid volume to mathematical communication of student in problem solving story. Learning obstacles are: students haven't able to use mathematical concept to mathematical models, to use mathematical concept to life, and haven't able to use therelationship between mathematical topics in life. To minimize learning obstacles for concept of cuboid volume, then drafted a didactical design. Didactical design organized at SDN Rahayu Kecamatan Mangkubumi, Tasikmalaya as much as 2 (two) cycles, are preliminary didactical design and revised didactical design. Preliminary didactical design implemented to minimize learning obstacle for mathematical communication skills for concept of cuboid volume and revised didactical design to fixing Preliminary didactical design. Didactical Design Research consists of three phases: 1) analysing of didactical situation before learning be in the form of Hypothetic Didactical Design, including ADP; 2) Metapedadidactical Analysis; 3) Restropective analysis between result of hypothetical didactical situation analysis with analysis result of metapedadidactical analysis. This research can increasing mathematical communication understandings and skills for concept of cuboid volume.

Keywords: *Learning obstacle, Didactical Design, Cuboid Volume, Mathematical Communication*

I. INTRODUCTION

Based on article 31 point 1 of The *1945 Constitution* of the Republic of Indonesia "Every citizen has the right to receive education". Curriculum is a educational foundation in school. In Kurikulum Tingkat Satuan Pendidikan (KTSP), mathematics is one of mandatory subjects in every level of education, include elementary school. Mathematics is used in all fields of science as well as having an important part in solving the problems in life. Therefore, mathematical knowledge should be mastered by the students as early as possible. Understanding the concepts of material in the mathematical learning in elementary school is an implicit prerequisite to continue their education to a higher level.

Education aims to humanize humas, make not knowing to knowing, and can't be able to able. Aim to improve the quality of human resources in education, referes to act of the republis of indonesia number 20 year 2003 article 3 "The National Education functions to develop the capability, character, and civilization of the nation for enhancing its intellectual capacity, and is aimed at developing learners'potentials so that they become persons imbued with human value who are faithful and pious to one and only God; who possess morals and noble character; who are healthy, knowledgeable, competent, creative, independent; and as citizens, are democratic and responsible.". In addition, education is also one way of formulation of the human ability to use reason effectively and efficiently as the answer to face with problems that arise in creating a better future. But in reality, education hasn't reached its intended purpose, both in terms of the learning process and the result of the students' achievement, not show satisfactory results.

The problem of education has always been an interesting topic, both among teacher, parents, even among the educational expert. This is something that is fair because everyone wants the best education for students as the iron stock for our nation. One of the problems of education is on math, this is stilll due to low student achievement in that subject. Efforts to improve the quality of mathematics education in Indonesia has long been implemented, but complaints about the difficulty of learning mathematics still continue to be found.

Mathematical learning is identical to drill critical thinking skill of students.Geometry is one of material of mathematics at elementary school. Understand and calculate the cuboid volume is one thing to be achieved student of elementary school in mathemaical learning. Questions about cuboid volume usually presented with picture and the students were only instructed to calculate the cuboid volume. Related to that, the students presented only the usual problems or questions, so that when students faced to the unusual problems, student will have difficulty and will not be drill to have critical thinking.

Based on the condition of cuboid volume learning, the research is aimed to developing of learning design collaborate with a variaty of learning methods, media, and techniques which is relevant. This research expected to improve mathematical learning process, especially on the material of cuboid volume in elementary school. With the development of learning design expected to facilitate students to think critically is every learning, especially mathematics.

Based on the research background, the formulation of the problem in this study is "How to didactical design in computing and understanding the concept of cuboid volume to improve the mathematical communication in students?".

Start from the formulation of problems, then drafted specific research questions as follows:

1. How a learning obstacle experienced by elementary school student in the material of cuboid volume?
2. How the didactical design to resolve of learning obstacle of student in the material of cuboid volume?
3. How implementation of didactical design on student in the material of cuboid volume?

The research purposes to be achieved is "Development of learning design of cuboid volume to mathematical communication of student in story problem solving in grade V of elementary school". While specifically, the research purposes to be achieved are:

1. To know and understand a learning obstacle experienced by elementary school student in the material of cuboid volume?
2. To desribe the didactical design to resolve of learning obstacle of student in the material of cuboid volume?
3. To describe implementation of didactical design on student in the material of cuboid volume?

Benefits of research are: 1) The theoritical benefits and 2) The practical benefits. The theoritical benefits are: expected to contribute positively in the development of the theory of mathematical learning, especially on the material of cuboid volume to improve the quality of education corresponding national education goals. Then, the practical benefits are:

a. For the teacher, as an input to develop innovative learning design in order to achieve optimal learning objectives, and to pre-service teacher as a preparation to face the profession.
b. For the student:
   1) Get a new material about cuboid volume;
   2) Improving the understanding of the concept of cuboid volume;
   3) Drill for critical thinking in the learning process.
c. For reseachers, can obtain direct experience in developing instrument and didactical design of cuboid volume.
d. For schools, contribution of ideas in written form related learning of cuboid volume.

II. RESEARCH METHOD

Sugiyono (2007 , pg.6) suggests that "the research method can be interpreted as a scientific way to get valid data to be found, developed and demonstrated that in turn can be used to understand, solve and anticipate a problem". Method used by researcher on this study is Didactical Design Research.

Didactical design is a learning plan form of teaching materials which aiming to reduce or eliminate learning obstacle based on the preliminary study. So that students being able to understand a concept or operates whole learning materials. The purpose of this didactical design is to reduce and eliminate learning obstacle on student so they are able to understand a concept as a whole.

Didactical Design Research consists of three stages, namely: (1) situation didactical analysis before learning process in the form of a didactical design hypothesis including ADP; (2) Metapedadidactical analysis, and (3) Retrospective analysis which relating the outcome of situation didactical analysis hypothesis and metapedadidactical analysis.

III. RESEARCH FINDINGS

A *cuboid* is a three-dimensional space formed by three pairs of square or rectangular, with at least one pair of which sized differently. A *cuboid* has 6 faces, 12 edges and 8 vertexes. A *cuboid* is formed by six congruent squares called a *cube.*The concept of *cuboid* volumes surely cannot be separated with components of the *cuboid*. Generally in schools, including elementary schools (SD), it involves the length, width, and height of the *cuboid* or better known as *length* x *width* x *height = volume.*

The first step of this DDR based research is organising preliminary study instruments. This instrument contained Competency Standard (SK), Basic Competency (KD), Learning Obstacles, Mathematical Communication Indicator, and Learning Indicator. SK and KD adjusted to School-based Curriculum (KTSP) which cuboid concept is one of them. As for Mathematical Communication Indicator which contained on the preliminary study instrument and the goal of this didactic design are:

a. Students are using the concept/ mathematical language to interpret mathematical idea.
b. Students are able to state the mathematical concept into mathematical model.
c. Students are able to pour the mathematical concept on their daily lives.
d. Students are able to understand the relation among mathematical topics to daily life.

Based in the preliminary study which had done on October 23rd 2015, learning obstacles was found. There three types of learning obstacles found, namely:

a. Type 1: Learning obstacle related to pour mathematical concept into mathematical model;
b. Type 2: Learning obstacle related to pour mathematical concept to the daily life;
c. Type 3: Learning obstacle related to pour mathematical topics to the daily life.

The next step after the obstacles obtained is creating learning didactical design. Learning didactical design was made in order to achieve learning goals. This didactical design, which researcher used, is related to the concept of cuboid volume and was done in 2 cycles (2 meetings) at SDN Rahayu Kecamatan Mangkubumi.

Early didactic design (cycle 1) was done during 2 hour learning time on Saturday, November 7th 2015. Based on the learning indicator and to achieve goal desired, the learning process was also done based on learning steps in lesson plan *(*RPP*)* which directed students to achieve learning goal. Learning process on the first cycle, intended to make students understand the concept of cuboid volume, then students were guided to do the student worksheet (LKS), in which students were doing with the their learning group. The groups were formed using colored paper, which let the students who picked the same color in the same group. After the learning groups formed, the students were given a worksheet consists of 3 activities to do with their group. Each group was guided by researchers while doing the activities. In early didactic learning design (cycle 1), students needed an intense guidance because the problems on the worksheet were not usual problems for them. Moreover, to explain about the concept of cuboidvolume in the first cycle Medias are needed, therefore, researchers used a cube and rectangular prism. With those medias, researchers was hoping the students could understand the concept of cuboidvolume, so the students are able to solve problems related to cuboidvolume. Each learning groups were evaluated after finishing the worksheet.

Since on early didactical design revision is needed, a revised didactical design was created. The revised didactical design was organised based on the implementation in the previous cycle. Based on early didactical design, there were things which need revision, and things which were revised are: The learning process is going to be done individually, the evaluation process is going to be done individually, and the duration is to be prolonged; from 2 x 35 minutes to 2 x 40 minutes and problem alteration.

The revised didactical design (cycle 2) was done on Friday, November 13th 2015 at SDN Rahayu. This revised design was intended to improve learning process which had done on earlier cycle (cycle 1). In this revised design, the difference between the earlier cycle and the second cycle was on the worksheet which done individually. This revised design shown different things compared to the early didactic design, in the revised design, researchers were not providing medias, because researchers believed that the students were already understood the concept of cuboid volume. The students were already understood the concept of cuboidvolume, it was proven as the need of guidance from researchers to students was decreased.

IV. RESEARCH DISCUSSION

Based on preliminary study, it was revealed that there are three types of learning obstacle, namely:

a. Type 1: Learning obstacle related to pour mathematical concept into mathematical model
b. Type 2: Learning obstacle related to pour mathematical concept to the daily life
c. Type 3: Learning obstacle related to pour mathematical topics to the daily life.

All three types of learning obstacle, was revealed from preliminary study which had done before didactical design. To minimize all three types of learning obstacle, then didactical design was done which consists of early didactical design and revised didactical design. to minimize the learning is through LKS obstacle to learning in any didactical design. LKS learning in every didactical design was a method to minimize learning obstacle.

Students learning obstacle could be resolved and minimized by didactical design, it was proven with the increased of students mathematical communication understanding in each meeting, one of characteristic is guidance from researchers to students was decreased and final evaluation of this research was increased from a preliminary study.

Implementation of didactical design at SDN Rahayu Kecamatan Mangkubumi, Tasikmalaya, was done in 2 cycles. There was increased of students mathematical communication concepts of cuboid volume from early didactical design to revised didactical design. Teaching method of early didactical design and revised didactical design were same, which was guidance finding method. However, the guidance from researchers was decreased from early didactical design to revised didactical design because the students were already understood and appliedtheir communication skills in problem solving.

V. CONCLUSION

Based on the result of research and discussion, it can be concluded:

1. Based on preliminary study, it was revealed that there are three types of learning obstacle, namely:
   a. Type 1: Learning obstacle related to pour mathematical concept into mathematical model
   b. Type 2: Learning obstacle related to pour mathematical concept to the daily life
   c. Type 3: Learning obstacle related to pour mathematical topics to the daily life.
2. To minimize all three types of learning obstacle, then didactical design was done which consists of early didactical design and revised didactical design.
   a. Didactical design was done at SDN Rahayu Kecamatan Mangkubumi Kota Tasikmalaya in fifth grade with 25 students.
   b. Students learning obstacle could be resolved and minimized by didactical design, it was proven with the increased of students mathematical communication understanding in each meeting, one of characteristic is guidance from researchers to students was decreased and final evaluation of this research was increased from a preliminary study.

VI. SUGGESTION

Based on the result of research and conclusion, then the researcher have some suggestions, as follows:

1. The didactical design has been drafted is one of the learning design of teaching materials that can be used in each lesson can be developed according to the needs.
2. This research is expected to continue to be develop by drafting the didactical design better about mathematical communication in concept of cuboid volume

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ME– 16

The Characterization Of Mathematics Students' Metacognition Process In Solving Mathematical Problems

by
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Abstract-It is an article as the result of a study to analysis happening of mathematical students' metacognition changes in solving and describing the characteristic of mathematical problem. The metacognition is based on the changes of awareness, evaluation, and regulation as the components of it. To make known of them, the writer has determined the indicators of each of the components which are spelled out into descriptors in order the process of metacognition changes can be seen. The process of the study involved 23 Students of Mathematics Department who finished Differential Calculus lesson as the subjects of the study. The subjects of the study were given mathematical problems about the application of function derivation to make known of the maximum area of a field. The data of the study was obtained consists of mathematical problem worksheet, record, metacognition questionnaire, and interview transcript. Then, the data was analysed by using Glaser's and Strauss' constant comparative models. Based on the analyzing, it can be inferred that the characterization of mathematical students' metacognition changes in solving mathematical problems can be classified by three categories: (1) metacognition changing process with complete-order indicator, (2) metacognition changing process with complete-disorder indicator, and (3) metacognition changing process with incomplete indicator. During the happening of the process of metacognition changes, the subject of the study, carried out the activities which are suitable to awareness, evaluation, and regulation indicators determined.

Key Words: *metacognition, awareness, evaluation, regulation, mathematical problem*

I ACKNOWLEDGEMENT

Mathematics owns direct and indirect objects. According to Gagne (Soedjadi, 2000; Hudojo, 2008) direct object consists of fact, concept, operation, and principle. While indirect object consists of logical thinking capability, problem solving, analytical thinking, positive thinking against mathematics, carefulness, perseverance, discipline, and the other cases which will implicitly obtain if someone learn mathematics. One of the objects is concept. The orientation of the concept of mathematics can be done through learning activity. Djamarah (2008) states that someone who owns the concept could carry out the abstraction. So that, he or she is able to translate and invite awareness and form mental representation. During understanding the concept, someone needs a specific ability and strategy. Duffin and Simpson (2000) states that the ability owned by someone during the understanding the concept is expected to be able to re-express the subject communicated to the source of learning, so that could solve the problem.

Polya (1988) mentions four steps to solve the problem, e.g. understanding the problem, planning the action, carrying out the planning, and reflecting the action done. The step expressed by Polya in solving the problem is the activity which can be observed during learning activity and as the measurement of completeness of learning result. According to taxonomy Bloom, the completeness of learning result is differentiated in the field of cognitive, affective, and psychomotor. Anderson, Krathwhol (2001) improves taxonomy Bloom cognitive field into two dimensions: the process of cognition and knowledge. The process of cognition consists of remembering, understanding, applying, analysing, evaluating, and creating. While knowledge is divided into the factual, conceptual, procedural, and metacognition.

Metacognition consists of *meta* and *cognition*. *Meta,* Greek, means after or behind and *cognition* is the process of getting knowledge. (Zahmeister & Neyberg. 1982). Metacognition can be related to the activity of solving problem, knowledge, and cognition or the strategy used during the learning process. At first, the term of metacognition was used by Flavell in 1976. According to him, metacognition consists of knowledge, experience, and regulation. Besides, Flavell stated that metacognition is use as the important element and play an important role in the success of problem solving. However, someone often fail to solve the problem. The main cause of it is the lack of metacognition aspect, especially relating to the steps of problem solving. (Schoenfeld, 1992; Goos, 1995;). In its progress, metacognition can help mathematics thinking process effectively. (Clarke, 2004). While Schoenfeld regards that the difficulty of solving problem is closely related to student's disability to observe and control their process of cognition (Schoenfeld, 1987).Some studies of the relationship between metacognition and problem solving had been carried out, such as Desoete (2001), Lioe (2003), Wilson & Clarke (2004), Cromley (2005), Efklides (2006), Lesh (2007), Panauorra (2009), Kuzle (2011), Molenar (2011), Karan & Irizary (2011), Magiera & Zawojewski (2011), In'am (2012), Praba (2013), Zarimah & Tajudin (2013). The studies have not expressed the characteristic the process of metacognition in detail. Relating to the process of problem, researchers did their studies to describe the characteristic of the process of metacognition to mathematical students in solving mathematical problems. The characteristic of the process of metacognition in the study is described based on *awareness*, *evaluation*, and *regulation*, the components of metacognition.

II. THEORITICAL STUDY

A. The definition of Metacognition

Friedrichs & Hoyt (1976) calls metacognition in term of metamemory, while Veenman (2012) describes it as two main parts: knowledge of metacognition and regulation, and observing metacognition. Knowledge of metacognition is an offer of interaction between someone's knowledge and ability to do his or her duties, characteristic of duties, and strategy used to solve them. Regulation or observation of metacognition is the activities relate to one's planning, monitoring, evaluating, and the process of cognition to control the process. Metacognition is a process which has four important aspects. According to Baker & Brown (1984), the four aspects are self-controlling, planning, evaluating, and monitoring. Wellman (1985) states that metacognition is a form of cognition or a process more than second level of thinking which involves controlling of cognition activities. That's why, metacognition can be said as a someone's thought about thinking of her or his self or someone's knowledge of cognition.

Besides having four aspects, according to Schoenfeld (1992), metacognition is a process of someone's thinking about being thought and interaction among three important aspects: knowledge of thinking process, self-controlling, and intuition. The interaction is very important for the knowledge of process of cognition can assist and control cases around us and select the strategies to increase our further cognition ability. The process of metacognition, according to Schoenfeld, are the ability to question and answering the questions about case, topic and subject, duration of time used by the students to study a certain topic, strategy, method and tactic, level being studied, failure done by the students, and dong revision to the next plan.

Livingstone (1997) defines metacognition as *thinking about thinking*. In other word metacognition is someone's ability to think about he or she thinks, so that metacognition object is thinking process happens to her or himself. Biryukov (2003) expresses that metacognition is someone's prediction about his or her thinking consisting of knowledge, skill, and experience. The knowledge as awareness of what being known, skill of awareness of what being done, and experience as awareness of cognition ability owned.

Davidson & Sternberg (1998), states that metacognition has a very important function and contributes towards the success of problem solving which enable someone to identify and work strategically. Matlin (1998) states that metacognition is a knowledge relating to awareness and cognition process. Wellman (1985) states that metacognition is a form of cognition or two levels or more thinking process involves control to cognition activity. That's why metacognition can be said as someone's thinking of his/her-self or someone's cognition of self-cognition.

Tan (2003) states that metacognition is thoughtfulness refers to think of self-thinking, self-controlling, self-checking, and information processing and how to process the information effectively. Lioe (2003) states that metacognition is someone's awareness of cognition process and stand lone lines to reach a certain goal. Metacognition appears in problem solving whose components are attitude, skill, concept, process, and metacognition. Peirce (2003) defines metacognition in general and specific. In general, metacognition is thinking of thinking. While in specific, Peirce adopts Taylor's metacognition definition saying that metacognition is an appreciation of what is known relating to the ability to make a right conclusion of how to apply someone's knowledge of strategy in a certain situation, and to do it efficiently and perfectly.Taccasu (2008) describes metacognition is a part of planning, monitoring, and evaluating the process of teaching and learning, thinking of what being known, or unknown and control the way to learn involving those two awareness and someone's learning awareness, so that learning will be effective. Mokos & Kafoussi (2013) states metacognition is someone's ability to observe and control her/him-self towards the known thing. During learning process, mathematics is an important thing of a study of students' metacognition process during solving problem focussed on the field of problem solving relating to mathematics.

Based on the definitions above, it can be identified the main meaning of metacognition, e.g. (1) metacognition is soul ability in cognition group, (2) metacognition is the ability to aware, know, the process of cognition happens in someone, metacognition is the ability to direct cognition process in someone, (3) metacognition is the ability to learn how to learn being done in the process of planning, observing, and evaluating, metacognition is a high thinking activity for the activity can control thinking process be doing on someone, and (4) metacognition relating to students thinking process of his/her thinking in order to find a suitable strategy to solve problem, (5) the skill of metacognition is very important to solve mathematical problem, so that the skill need to increase. To increase metacognition skill needs awareness owned by students in each steps of their thinking. Student's awareness is needed to think when solving the problem.

B. The Components of Metacognition

Magiera & Zawojewski (2011) find that metacognition happened during giving assignment in the class. Metacognition happening in the students has three components, e.g. awareness, evaluation, and regulation. During the process of metacognition, it can be seen the appearing activities in every components of metacognition called as types of metacognition activities. The types of awareness consist of what the students know, what the students need to solve the problem, what the students must do, where the students solve the problem. The types of evaluation consist of result evaluation, students' difficulty problem of evaluation, progress ability or understanding evaluation. The types of regulation consist of planning strategy, selecting strategy of problem solving, formulating the goal.

Awareness, according to Wilson & Clarke (2002, 2004), relates to someone's awareness in the process of learning or in the process of solving problem, the content of specific knowledge owned, and someone's knowledge in learning or strategy of solving problem. It is also about someone's knowledge about what is needed, what has done, what can be done in a certain learning or situation in solving the problem. *Evaluation* refers to evaluation made by someone about thinking process, ability and limitation, such as working in a certain situation or as a self-complication. For example, someone can make evaluation about thinking effectiveness done or strategy chosen. *Regulation* in metacognition happens when someone uses his/her skill of metacognition to direct knowledge and thought and refers to individual knowledge in the form of strategy, such as how and why using certain strategies, as well as skill, such as planning, self-correction, decide the goal to optimal the usage of their own cognition source.

Metacognition components stated by Wilson & Clarke (2002,2004) and Magiera & Zawojeski (2011) has indicators as variable and measurement. However, how the process of changes among the components of metacognition has not analysed deeper yet. Sriraman (2003) has considered students about the relationship between their knowledge and what is needed in problem situation given, as Stillman & Gabraith (1998). *Evaluation* has been described and studied concerning the students explicit reflection during the process of solving problem, the function of evaluation in determining the strategy in solving problem. Make a decision in systematic evaluation, alternative plan, and strategy insolving problem (Lester, 1980; Lester, Garafalo, & Kroll, 1989). *Regulation* has been clarified in the form of student flexibility in choosing a solution plan, choosing strategy, and plan implementation improved by Lester (1989), Zan (2000).

C. THE METHOD OF THE STUDY

The study done is qualitative descriptive whose subject is 23 university students. The method and steps of study are (1) giving mathematical problem to the students who have got Differential Calculus as the subject of the study. The mathematical problems are about function downward application to determine maximum and minimum value. The problems have been validated by 2 experts in mathematics and mathematics education. During doing the problems, the subject do and being recorded. (2) Researchers correct the result of students' works based on the answer-key made before. Based on it, subjects of study are classified into high, middle, and low ability students. (3) Give questionnaire.It is given after the students finish doing mathematical problem. It consists of 14 items to measure the process of metacognition happened to the students. It is the improvement of research done by Biryukov (2001), Azsoy & Ataman (2009), Meriam & Idrus (2010), Panaoura (2010), Sengul & Katransi (2013). (4) Doing the interview. It is based on the result of students' works, record,questionnaire answers. It is done to make deeper known about the characteristic of the process of *awareness, evaluation, and regulation*. It is done after students carry out . Interview protocol is arranged by improving the indicators of *awareness, evaluation*, and *regulation*. (5) Doing transcription the record of and interview. The transcription is done for obtaining the data of each of the subject of the s tudy of the characteristic of metacognition process during finishing mathematical problem relating to students ability.(6) Reduce the data. Reducing the data is done by making abstract in the form of summary of data core, process, and statements done by the subject of the study in finishing mathematics problem as well as arranging the data in parts which will be categorised by *coding.* (7) Data analysing, analysing metacognition process each of the subjects of the study though each indicators *awareness, evaluation*, and *regulation*. (8) Data validation, data validation is done using triangulation technique and checking classmates through discussion. Triangulation used is source one, that is comparing the result of observing during the subject finishing mathematical problems, the result of students works, , questionnaire answers, and interview.

D. THE RESULT OF STUDY AND DISCUSSION

The data of the study is in the form of the result of student works of finishing mathematical problems, the record of , the answers of metacognition questionnaire and the interview transcript is studied and analysed qualitatively. The theory design built by the researcher is analysing the characteristic of the student metacognition process in finishing mathematical problems through indicators of *awareness*, *evaluation*, and *regulation.* Based on the theory design, the result of analyse of the study is grouped into category of characteristic of student metacognition process of high, middle and low ability.

During the study, researchers gave mathematics problems to 72 students of Department of Mathematics Education who finished programming the subject of Differential Calculus. The process of metacognition was observed to describe and analysis. Description and analysis done relate to the characteristic *awareness*, *evaluation,* and *regulation.* The result of the initial observation and analysis show that 23 students did the complete metacognition as follows: 6 students are in high ability, 9 students are in middle ability, and 8 students are in low ability.

Based on the result of the study, each of the subjects of the study in each group has characteristic which are relatively same. So hat, there are 6 subjects of data explanation done by the researchers in describing the characteristic of the process of metacognition. They are 2 high ability students symbolized by S-1 and S-2, 2 middle ability students symbolized byS-3 and S-4, and 2 low ability students symbolized by S-5 and S-6.

Next, the characteristic of metacognition process of those three subjects of the study were examined through the indicators of *awareness*, *evaluation*, and *regulation*. The component of *awareness* has 5 indicators. They are the subject of the study re-think of what was known about given mathematics problems given (A1), re-think the question of mathematical problems and related it to the similar problem gotten and done before (A2), re-think the undone thing (A3), re-think the next steps to do (A4), and re-think the steps done (A5).

The component of *evaluation* has 5 indicators. They are the researchers re-think the way to solve the problems (E1), re-think the order and steps to do (E2), re-check the answers (E3), re-think whether the answers are right or wrong (E4), and re-think the failure done in answering mathematical problems which were given in the last way (E5).

The component of *regulation* has 4 indicators. They are the subjects of the study re-think and make a plan to finish mathematical problems (R1), re-think the different way done in answering mathematical problems (R2), re-think of what will do after finishing answering mathematical problems (R3), and re-think how to change the way. The process of the happening of metacognition can be described as follows:

A. The Process of High Ability Students Metacognition

The subject of the study in high ability S-1 and S-2 have same characteristics of metacognition process. During the metacognition process, S-1 and S-2 show the activity that describes the characteristic of component indicators *awareness*, *evaluation*, and *regulation*. When finishing mathematics problems, the indicators of mathematical problems appeared in order: A1, A2,A3, A4, A5, E1, E2, E3, E4, E5, R1, R2, R3, and R4.The order of appearing indicators on S-1 and S2 can be seen on the figure 4.1

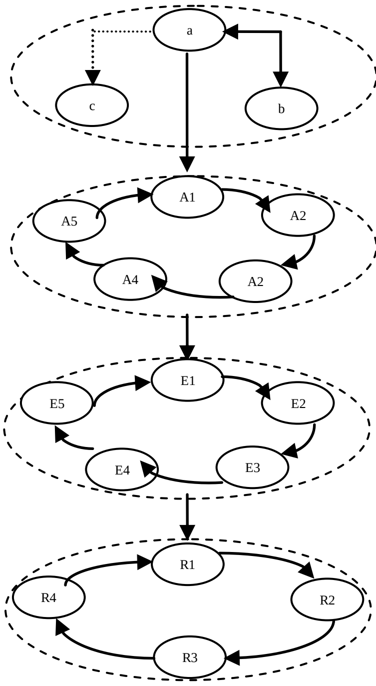
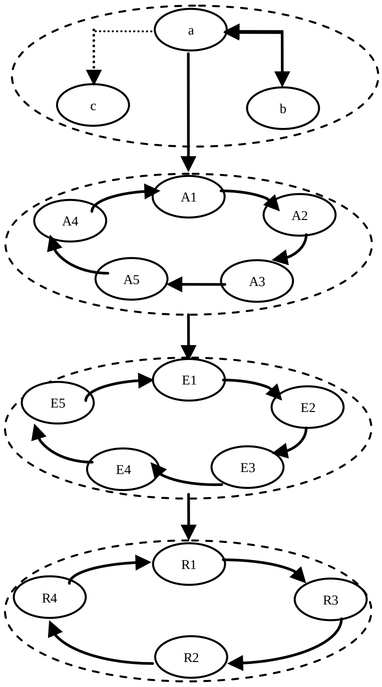


Figure 4.1: Metacognition Process S-1 and S-2

B. The Process of Middle Ability Students Metacognition

The middle ability subject of the study, S-3 and S-4 carried out metacognition process with complete indicators but disorder. When finishing the problems, the indicator in S-3 appeared in order A1, A2, A3, A5, A4, E1, E2, E3, E4, E5, R1, R3, R2, and R4. The indicator in S-4 appeared in order A1, A2, A3, A4, A5, E1,E2, E3, E4, E5, R1, R2, R4, R3.

The order of appearing indicator in S-3 can be seen in figure 4.2 and the order of appearing indicator in S-4 can be seen in figure 4.3



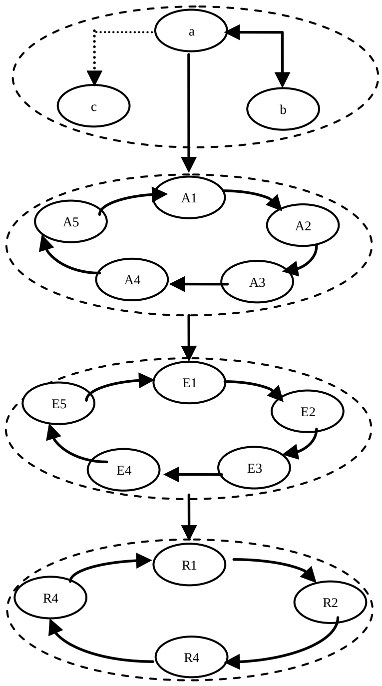


Figure 4.2: The process of Metacognition S-3 Figure 4.3: The Process of Metacognition S-4

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C. The Process of Low Ability Students Metacognition

The low ability subjects of the study are S-5, and S-6. The changes of metacognition process S-5 and S-6 showed the activities that described the characteristics of indictor *awareness*, *evaluation*, and *regulation*. When finishing mathematical problems, the indicator in S-5 appeared in the order A1, A3, A2, A4, A5, E1, E2, E3, E4, R1, R3, R2, R4, R3.The order of appearing indicator in S-5 can be seen in figure 4.4 and the order of appearing indicator in S-6 can be seen in figure 4.5

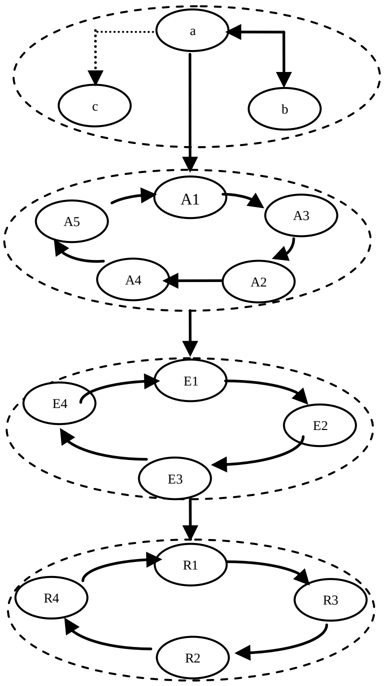

Figure 4.4: The process of Metacognition S-5

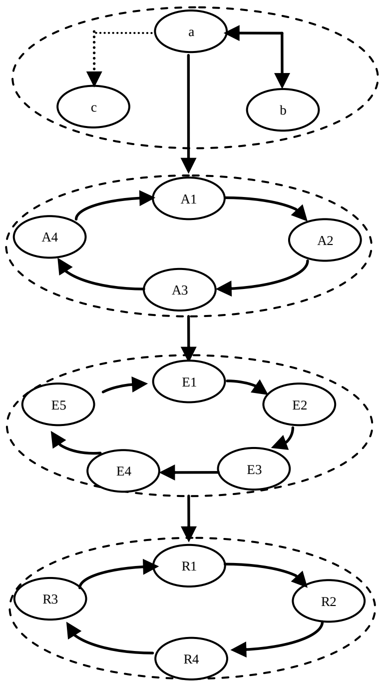

Figure 4.5: The Process of Metacognition S-6

The finding of the result of the study can be related to the previous theory as the basic of the study. If relating to the opinion of Wilson and Clarke (2002, 2004), each of the characteristic of the components are activities concerning with someone's ability to think of what he/she has done when finishing the problem. The problem of the study is how the subject of the study can find out the believed ways as the answers of the mathematical problems. The belief of the subject of the study is based on the process of evaluation and regulation done and as a part of abilities to observe and control him/her-self toward something known. Self-controlling can be done when finishing the problems (Mokos & Kafoussi, 2013). In a accordance with the indicator during the process of metacognition happened, it can be seen that the activities are the types of metacognition activities.The type of awareness is what the students know, what students need to finish the problems, what the student must do, where the students were. The type of evaluation activities result of evaluation, grading of students' difficulties problems, grading the improvement, ability, and understanding. The type of regulation activity is the strategy of planning, selecting the strategy, formulating the goal. Magiera & Zawojewski (2011).

E. CONCLUSION

Based on the data analysis, it can be inferred that high ability students are in complete and order of their characteristic of metacognition process, middle ability students are in complete and disorder of their characteristic of metacognition process,while low ability students are in incomplete of their characteristic of metacognition process.

The complete and order of characteristic of metacognition process is in S-1 and S-2, the complete and disorder of characteristic of metacognition process is in S-3 and S-4, and the incomplete characteristic of metacognition process is in S-5 and S-6 can be in detail as follows: The component *awareness* with A1 brings out 6 characteristics, A2 brings out 7characteristics, A3 brings out 5characteristics, A4 brings out 8 characteristics, and A5 brings out 4 characteristics. The component of evaluation with indicator E1 brings out 6 characteristics, E2 brings out 6 characteristics, E3 brings out 6 characteristics, E4 brings out 4 characteristics, E5 brings out 4 characteristics. The component of

regulation with the indicator R1 brings out 5 characteristics, R2 brings out 3 characteristics, R3 brings out 4 characteristics, R5 brings out 6 characteristics.
The explanation of the order of indicator of 6 subjects of the study can be clarified as in the following table.

TABLE 1: The Order of Metacognition Process of Subject of Study

No.	The Subject of the Study	The Component of Metacognition	The Order of Indicators
1.	S-1 and S-2	*Awareness*	A1, A2, A3, A4, A5
		Evaluation	E1, E2, E3, E4, E5
		Regulation	R1, R2, R3, R4
2.	S-3	*Awareness*	A1, A2, A3, A5, A4
		Evaluation	E2, E1, E3, E4, E5
		Regulation	R1, R3, R2, R4
3.	S-4	*Awareness*	A1, A2, A3, A4, A5
		Evaluation	E1, E2, E4, E4, E5
		Regulation	R1, R2, R4, R3
4.	S-5	*Awareness*	A1, A3, A2, A4, A5
		Evaluation	E1, E2, E3, E4
		Regulation	R1, R3, R2, R4
5.	S-6	*Awareness*	A1, A2, A3, A5
		Evaluation	E1, E2, E3, E4, E5
		Regulation	R1, R2, R4, R3

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ME– 17

Students' Anxiety Facing Computer Based Test (CBT) System of National Examination

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Abstract—National examinations in education sometimes become a debatable issue among various groups. In response, the government made changes for the better education in national examination system. National examination that was originally done in written form (Paper Based Test/PBT) changed into a computer system or (Computer Based Test/CBT) in academic year of 2014/2015. Changing the PBT national examination into the CBT national examination was because the CBT national examination had more benefits than the other. However, the limited human resources in the management of test facilities that support the implementation of CBT national examination became one of the things needed to be considered and paid attention to, especially for students who would have the CBT national examination. It was a new thing that triggered students' anxiety, not to forget mentioning that the examination itself was already made them anxious. This study was a survey done by using questionnaire method given to the senior high school students in 3rd grade in Yogyakarta province. The results of this study are: (1) generally, students' anxiety is in medium level. Science students' anxiety in the idea of having CBT system for the national examination is medium level, and it is in similar level for the social students; (2) there is no relation between the students' anxiety with their major (natural or social science).

Keywords: *students' anxiety, computer based test, national examination*

I. INTRODUCTION

Education is important for the sustainability of every individual. Therefore, the quality of education must be improved for the better. One of the forms of education evaluation in Indonesia is by conducting the national examination. National examination is one of the policies made by the Indonesian government in terms of education, especially in the implementation of the final assessment at national level of education. Assessment has an important role in the educational process. It is also considered as an important measurement tool in evaluating the student's performance. In addition, the assessment is important as a process of obtaining information that is used to make decisions about the students, the curriculum and programs, and the educational policy [1]. The national examination is a form of evaluation of students, the education unit, and educational programs carried out by independent institutions on, thorough, transparent, systemic, and done on a regular basis, to assess the achievement of national education standards [2]. The national examination is the measurement and assessment of national competency attainment in certain subjects. National exam SMP / MTs, SMA / MA / SMAK / SMTK and SMK / MAK can be done through Paper-Based Test (Paper Based Test) and/or Computer-Based Test (Computer Based Test) [3]. However, not all of the schools in Indonesia implement the new CBT form of national examination. The CBT system is done gradually by certain schools that meet the requirements.

CBT national exam has already been implemented in 2014 in Indonesia-Singapore junior high school and Indonesia-Kuala Lumpur junior high school. The result was quite encouraging that it pushed the government in improving the students' literacy to ICT (Information and Communication Technology). CBT National examination system is an effective solution for carrying out the evaluation or educational assessment conducted on large number of students. This is also explained by the results of the research that the validity of web-based CBT tests given to large number of respondents is proved [4]. The statement that CBT test or exam is effective for educational evaluation with large number of participants is in line with the policy of the Indonesian government which is about the CBT national exam. However, schools to implement the CBT system are required to submit the confirmation on the school's readiness of implementing the system. Furthermore, a process checking is also essential, done by the official verification to ensure the school's readiness on facilities and infrastructure. The verification process covers the availability of computer laboratory, networking, switching devices, internet access, UPS, generators, server, client, and other supporting infrastructure [5]. The benefit of CBT national exam system is on the time division. It is divided into three sessions in a day. One subject is done in each session, resulted in a better integrity of the students. This is because the questions of examination appeared on each computer is different [6]. In addition, the different examination question for each student is proven to decrease cheating drastically [7]. Nonetheless, there are some students who may be anxious with the new system [8]. It is due to the general computer literacy level of the students.

Anxiety can be observed from the attitude or behavior of the person, on this discussion is the high school students. High anxiety of every level is observed from most of the students, caused by the CBT system implementation for the examination [9]. The test is similar with the national exam. National exam has positive and negative impact. One of the negative impacts is increasing students and teacher anxiety [10]. Anxiety happened to students will lead to certain traits or symptoms. Certainly, anxiety produces physical symptoms. In fact, some people suffer particularly from the changes in appetite, sleep, energy, or pain, when they are reported to be lost in their own thinking, showing behavior problems. In other opinion, Chess &Hassibi [11] stated that anxiety is defined as an unpleasant situation that is usually perceived as a fear of something that will happen and feeling irritable accompanied by anxiety, fatigue, and a variety of somatic symptoms such as headaches and stomach aches. Anxiety is an individual experience related to mental tension alarm as a result of public reaction and inability to confront the problem or their sense of security. Anxiety is accompanied by psychological and physiological signs. Psychological signs are including shaking, sweating, and increased heart rate. While signs of psychological panic are including tense, confused, and cannot concentrate [12]. Signs of emotional anxiety caused by examinations are over whelming feelings, helpless and hopeless, ashamed and worthless (feels like a failure), panic, unable to concentrate, complained of being ill, have an angry outburst or tantrum, fatigue, and difficulty in sleeping the night before the test [13]. In this case, one kind of test or exam that may cause anxiety in students is national exam that students at the end of every level of education should face. Now with the new CBT system of national examinations, the students are prone to experience higher anxiety. This statement is the idea of this research on studying the anxiety of the high school students in Yogyakarta regarding the implementation of CBT system on national examination.

The problem formulations of this study are: (1) how does the level of anxiety of high school students in Yogyakarta province in facing the CBT national examination? (2) Is there any influence between the students' major (natural or social science) and the anxiety level?

The aims of the study are: (1) to determine the anxiety level of the high school students in Yogyakarta province on the CBT national examination, (2) to determine whether there is any influence of major, which were natural science and social science, with their anxiety level. The benefits of the study are: (1) giving contribution to the conceptual studies on the effect of the government policy on the CBT system for national examination to the anxiety of high school students in DIY in facing mathematics national exam, (2) giving benefit to the schools because it could be used as the consideration for giving better guidance to the students in facing the national exam, so that their anxiety could be controlled, (3) being useful as information and knowledge for academic use and public use in general about the anxiety of high school students in Yogyakarta province caused by the implementation of CBT on the national examination, (4) being used as a basis for similar research in other provinces or for similar research with different variables.

II. RESEARCH METHOD

A. *Research Design*

This study was a survey conducted by using questionnaire created according to the theory of students' anxiety in facing CBT national examination. This study described the results of the analysis of the students' anxiety level.

B. *Research Subject*

The population in this study was all students of class XII (3rd grade) in Yogyakarta province which senior high school implemented CBT system for the national examination. Selected samples were seven schools in four regencies and one municipality. The regencies were Sleman, Bantul, Kulonprogo, Gunungkidul regencies, and also Yogyakarta municipality. The samples were 318 students, consisted of

167 science students and 151 social students. A science class and a social class were selected randomly from each school.

C. Research Procedure

The study was conducted on February 17th to March 5th, 2016. This study was a survey conducted by using questionnaire as data collection instrument. The questionnaire used five alternative options, which were always/strongly, agree, often/agree, sometimes/hesitations, rarely/not agree, and never/strongly not agree. The scale used was the Likert scale, in the range of 1-5. The higher the questionnaire score of the student, the higher the students' anxiety was.

After going through the validation phase, the questionnaire then was tested to determine its reliability. The questionnaire reliability was 0.824, and KMO's score was 0,720. Furthermore, the questionnaire was given to selected respondents or samples to obtain the research data.

D. Data Analysis

Data analysis was conducted after the data had been obtained. To analyze the data, first of all, it was analyzed by using central tendency analysis. It consisted of the average, median, mode, standard deviation, maximum score, and minimum score. The data then was analyzed to determine the level of anxiety of the high school students. It was analyzed by using the criterion table of anxiety score. The last, the data was analyzed to find out the anxiety level of the sample, both from the science and social studies majors. It was focused on whether there was any influence of major, which were natural and social science, with the anxiety of high school students in Yogyakarta province. The data was analyzed by using different average test (independent sample t-test).

III. DISCUSSION

The discussion in this study consisted of two main discussions. The first discussion will be the discussion as a whole on the level of anxiety of high school students in Yogyakarta province in the CBT national exams. It will be adapted to table criteria. The second, the discussion will determine whether the difference in major, whether it is natural science or social science, could influence the anxiety level of the high school students.

A. Anxiety Level of High School Students in Yogyakarta Province Facing CBT National Exams

Data description of high school students' anxiety is shown in Table 1.

TABLE 1. DATA DESCRIPTION OF STUDENTS' ANXIETY FACING CBT NATIONAL EXAM

	Natural science class	**Social science class**	**Total**
Number of students	167	151	318
Average	86,521	84,099	85,31
Median	88	84	87
Mode	88 and 89	83	88
Standard Deviation	12,584	12,907	12,775
Maximum score	118	115	118
Minimum score	48	45	45

The table shows that the average level of the high school students' anxiety for natural science major is at 86.521 and the average level of the social science students' anxiety is at 84.099. It is clear that the average level of anxiety of natural sciences major is higher than the social sciences. Reflected in the table also the median and the mode of natural science students are higher than the social students'. Moreover, from the standard deviation, it can be seen that students in social science class scored higher than the students in natural science class. The maximum and minimum scores of natural science students are also higher compared to the students of social sciences'. However, both majors have similar range of score, exactly a score of 70.

Overall, the number of students 318 provides an average 85.31, median 87, mode 88, and standard deviation 12.775. As for the maximum value and the minimum value includes both science and social groups, the maximum value is 118 and minimum value is 45. The values can be categorized based on the criteria for the anxiety level of high school students in Yogyakarta province facing the CBT national examination by using the criteria as served in Table 2 [14].

TABLE 2. CRITERIA OF STUDENTS' ANXIETY

Interval	Category	Criteria
$Mi + 1{,}5Si < X \leq Mi + 3Si$	$120 < X \leq 150$	Very High
$Mi + 0{,}5Si < X \leq Mi + 1{,}5Si$	$100 < X \leq 120$	High
$Mi - 0{,}5Si < X \leq Mi + 0{,}5Si$	$80 < X \leq 100$	Medium
$Mi - 1{,}5Si < X \leq Mi - 0{,}5Si$	$60 < X \leq 80$	Low
$Mi - 3Si < X \leq Mi - 1{,}5Si$	$30 < X \leq 60$	Very Low

Based on Table 2, it can be stated that the average level of anxiety of the natural science students is 86.521. The category is medium. Moreover, the average level of anxiety of the social science students is 84.099. The category is also medium. In general, the average level of anxiety for both of the majors is 85.321, which is categorized as medium criteria. CBT national exam is possibly a way of implementing the new exams for some students, despite of the fact that there will possibly be some students who are not accustomed to using the computers. In fact, the results of the study stated that the student anxiety is at the medium level. It can be concluded that the students are generally able to overcome a sense of anxiety in them, so that the students will have them in control.

The anxiety that these students are feeling when it comes to the CBT implementation for the national examination can also be a positive energy when it is not excessive. It can be used as encouragement for students to get better exam results. Students with high level of anxiety will have lower cognitive achievement, while students with low anxiety will have higher cognitive achievement [15]. In the other hand, excessive anxiety may cause a psychological impact on students. The test results may also not reach its optimum possibility.

The results are consistent that the anxiety experienced by students regarding the implementation of national examination is actually a strong cause that motivates the students to learn and try (79.1%) [16]. The high students' motivation of learning and students effort will bring good result. Motivation and effort being mentioned will be able to help the students control and lower the students' anxiety in facing the examination. It can also lead to better concentration while doing the examination, for one of the symptoms anxiety can cause to an individual is a low level of concentration or being "blank" during the test [17].

B. Analysing Whether There Is Any Relation between The Students' Major and The Anxiety Level of High School Students in Yogyakarta Province in Facing CBT National Examination

This analysis is conducted by using different average test (independent sample t-test). Before analyzing, the data must fulfill the assumption test. By means assumption test here are normality test and homogeneity test. The hypothesis used in the test for normality is as follows:

H0: Data distribution is normal

H1: Data distribution is not normal

The result of the analysis showed that the Kolmogorov-Smirnov normality for the data of science students' anxiety is 0.062. It is greater than 0.05. Its consequence is H0 is accepted. It means that the data distribution is normal.

The next assumption is homogeneity test. Hypothesis used in the test for homogeneity test is as follows:

H0: Variance data of science and social groups is homogenous

H1: Variance data of science and social groups is not homogenous

By using Levene's test, the result of the analysis is 0,711. It is greater than 0.05. Its consequence is H0 accepted. It means that the data variation of science and social groups is homogenous.

After testing the assumptions, the data was continued to be analyzed by using different average test. The analysis is done by using the independent sample t-test. The analysis made use of the data of high school students 'anxiety in Yogyakarta province facing CBT national exams in natural and social science. This test aimed to determine whether or not the major of the students have influence to the anxiety level of senior high school students. The hypothesis in this analysis is:

H0: $\mu 1 = \mu 2$ (There is no significant influence between the anxiety level and the major, natural and social science, of the senior high school students in Yogyakarta province regarding the CBT national examination)

H1: $\mu 1 \neq \mu 2$ (There is a significant influence between the anxiety level and the major, natural and social science, of the senior high school students in Yogyakarta province regarding the CBT national examination)

The result of the analysis is significant with the value of 0.091. It is greater than 0.05. Its consequence is H0 accepted. It means that there is no significant influence between the anxiety level and the major, natural and social science, of the senior high school students in Yogyakarta province regarding the CBT national examination. Students majoring in natural or social science feel the same anxiety as they face the CBT national exam. The level of anxiety faced by both major is also not very different. This is because there is no difference in treatment regarding the implementation of CBT national examination between students of both major. Natural and social science carry the same CBT test for preparation (known as try out test), the same implementation schedule, the same schedule for the result, the same possibilities that can occur when the CBT national exam is implemented, such as problems about the electricity, computers, or networking. Besides that, each of the students from both majors has personal goals that must be achieved on the national exam. The determination of these targets can trigger their anxiety, and it appears on each student of both majors. In addition, students of both groups had to control their anxiety when facing the new computer-based national examination.

IV. CONCLUSIONS AND SUGGESTIONS

A. Conclusions

Based on the research results, there are two points that can be concluded from this study. The first is that the anxiety level of the senior high school students in Yogyakarta province in facing CBT national exams is categorized into the medium level. Students of natural science and social science major's anxiety level is also concluded to be in medium category. The second, there is no significant influence of major, which were natural science and social science, with their anxiety level of the senior high school students in Yogyakarta province.

B. Suggestions

Regarding this study, there are some suggestions. For a better study conducted in the future, it is suggested to the researcher to have bigger number for the sample and population, so that the scope of the research can cover wider research range. Moreover, it is suggested to have more variables in the study, so that the research can be seen in a wider point of view.

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ME– 18

Increasing Higher Order Thinking Skill to Build Student's Character by Using Mathematical Reasoning

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Abstract— This paper discusses about mathematical reasoning can increasing higher order thinking skill which can build student's character while learning process. In the process of mathematics learning, students will be faced on routine and non routine problems, so they need critical and creative thinking skills to solve the problems. Mathematical reasoning is one of goals from learning mathematics. There are five various types of mathematical reasoning, such that; 1) Algebraic reasoning, 2) Proportional reasoning, 3) Statistical reasoning, 4) Geometrical reasoning, 5) Probabilistic reasoning. With mathematical reasoning, teachers can provide space for students to think logically in understanding mathematics concepts and consider all the possibilities that exist to solve problems. In the process of finding the solution of this problem, students will require unusual thinking skills are often referred to as higher order thinking skills. Improved way of thinking in the process of mathematical problem solving can build performance and moral student's characters such as discipline, honest, responsible; never give up etc. Because there are six pillars of character such that, 1) Trust, 2) Respect, 3) Responsibility, 4) Fairness, 5) Caring and 6) Citizenship. If this characters be applied to life, it can helping students to facing developments and global challenges.

Keywords:*Higher Order Thinking Skill, Mathematics Reasoning, Student's character*

I. INTRODUCTION

The rapid growth of science and technology has made free flow of information accessible to everybody. The fact has shown that government is incapable of setting a certain limit to the accessibility and censorship of information which resulting in easy access to misbehavior. Weak parental and societal guidance in selecting information set the students as the only ones to decide for themselves of whatever information to be accessed. Brawling as an instance is a common reality presented by media technology. As this rampant phenomenon is shown, it then becomes a trend of the youth nowadays. Thus, like a tuberculosis, it spreads everywhere instantly from a certain place to another and from an educational institution to another.

Indeed there is a lot of accessible information either good or unhealthy ones whose unconfined accessibility can lead students astray. Consequently, the presence of the advantages and disadvantages of free access to this information influence the formation of students' characters. Aside from the problems arisen from the free access to information, the fact that human persons are relational being, there are indeed problems emerged in the relationship either with persons around the place where they live, with other students at school or with whoever they come in contact with. What is saddening nowadays is not anymore problems emerged from actual relationship with fellow students but rather problems encountered within virtual reality. The interaction and involvement of students with the latter reduce the necessary encounter with fellow students at school which basically formative.

However, regardless the above mentioned detrimental situations encountered by students, the government still has great hope for the schools which take into consideration the formation of students' characters. With the issue of Permendiknas No. 41 Tahun 2007 which talks about standard process, where in the learning process beginning from introduction, core substances, and conclusion, these three parts are taken into consideration so as to contain and give priority to expected values. This *Student Centered Principle* as it is called is above all aimed at the assimilation of values in life by students. Aside from that, teachers are expected to become living exemplars of how to live out of the values that they impart to the students.

Fundamentally in learning process the expected values to be achieved by students are integrated in every subject in the school not to exclude in Mathematics. The latter is the most common subject offered in school at any level. The main characteristic of this subject is not a usual skill as found in any other subjects. Its skill is called *Higher Order Thinking Skills* (HOTS). *Higher Order Thinking Skills* (HOTS) is a thinking process of how to find answers or solutions in the midst of difficult and tricky situations by way of taking and connecting new and stuck knowledge so as to make them wider knowledge. HOTS in Bloom's taxonomy, falls on the category of cognitive analysis, evaluation, and creation. This cognitive analysis and evaluation falls under critical thinking while cognitive creation is under creative thinking [1].

Indonesia is not included in the number of countries which are considered as well-versed in science and technology. This is because of the low achievements of our education. This low achievement is gauged from the ability of students in answering questions which demand higher thinking skills. Based on the datum given by PISA in 2012, from among 65 countries in the list, Indonesia is in the 64th rank when it comes to science and mathematical skills. Indonesian students are used only with common questions on first and second levels which consequently resulting in lower acquirement of grades when they are given questions based on PISA standard which are actually ranged from first to sixth level and basically contextual in their characters.

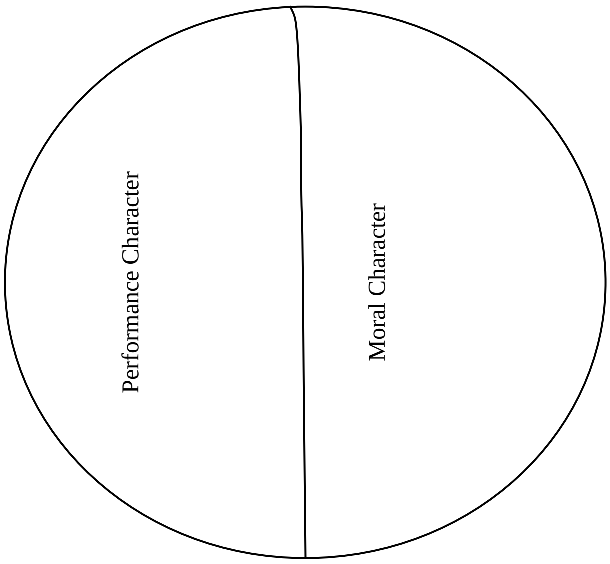
The government then applies 2013 curriculum with the perspective of facing the demands of education in this globalization era. The theme of the development of the said curriculum is a curriculum which is capable of producing Indonesian individuals who are productive, creative, innovative, and affective through the strengthening of good positive values, skills, and integrated knowledge. Competent attitudes expected from the students are those attitudes that mirror piety, honesty, high regard for discipline, responsibility, care, courteousness, responsive and pro-active behavior. Besides, students are expected to acquire factual, conceptual, procedural and meta-cognitive knowledge in different disciplines for them to be knowledgably competent. The latter demands students to possess the ability to act effectively and creatively so as to put into practice in the daily life methods and theories acquired in school.

The learning system contained in 2013 curriculum stresses the indispensability of HOTS. Students with HOTS are not only those who memorize to the letter the information imparted at school but they also have the ability to put them into practice at daily bases. They possess analytic mind as well. Mathematical reasoning offers new efficacious ways to build into awareness and to express ideas about varied and wide phenomena in this globalization era. Thus, students with analytic minds tend to cling on pattern, structure, and regularity or irregularity either in concrete situations of life or hypothetical ones.

II. STUDENT'S CHARACTERS

Human characters are different for each person, as well as student's character in the classroom. These differences are influenced by many factors; one of the factors is teacher's role in learning activities in the classroom. Teacher's role in the class may affect student's character, so teacher are expected to take more time to observe and learn student's character. Thus, teachers can choose appropriate learning methods to be able to build student's character. Characters are special markers that distinguish each person, or individual's qualities that made the difference. Naim [1] wrote in his book that character is a picture that shows attitude of right and wrong behavior, good or bad behavior. Characters can be classified into attitudes, behavior, motivation and skill, from those Naim wrote that characters include religious attitude, honesty, tolerance, caring, democratic, disciplined, hard working, independent, high curiosity, never give up, critical and creative. Hildebrandt & Zan [2] wrote that there are six pillars of character such that, 1) Trust, 2) Respect, 3) Responsibility, 4) Fairness, 5) Caring and 6) Citizenship. That opinion indicates that character will support human social life then can be used to deal with developments and global challenges. Through learning, students are expected to have a character that can support their social life. So, mathematics teacher are expected help student to build their characters through the process of mathematics learning.

Characters cannot be formed in short time, when teacher want to building the student's character they must be patient. Build student's character through mathematics learning is not easy, it is requires long time and continuously. However, character which build in this learning will be rooted on student's life. For example, when teacher divides students into small groups and ask them to discuss an issue then the characters that appear are tolerance, caring, curiosity and creative. Then, when the students were asked to convey their discussion's result, the characters that appear are democratic, critical and creative. When teachers provide an opportunity for students to corporate their abilities then the characters are formed will be better. Summarize the Piaget's opinions [2] that students who intellectually passive then they do not have independent themselves, so teachers are asked to give them a chance to be active intellectually.



Picture 1st. Performance and Moral Character by Matthew

Learning mathematics which given by teachers can be used as bridge for students to build their good characters. When teachers provide opportunities for students, it will minimize rebel's attitude or minimize moral damage that happens now days. As written by Matthew Davidson [2] in his research that characters are defined into two sections interconnected, there are performance character and moral characters. Performance characters include persistence, tenacity, work ethic, positive attitude, ingenuity and disciplined which used to support academic's activities, work and life. While the moral characters include integrity, fairness, caring, respect and cooperation are needed in interpersonal relationship. So, to able to treat other students with good attitude, then a student must be has a good character too. Mathematics teachers can also manage their learning mathematics to be able to support characters building as exemplified advance.

Students have different characteristics and should be used as one of the focus of attention in learning, so that optimal learning results obtained. Therefore, at least the teacher must know the character of each student. By knowing the character of their students, teachers will gain some of the benefits that would be used as one of the cornerstone in the implementation of learning activities. The benefits of such teachers can recognize the ability of the students, the student learning experience, the social background of students, the level of development and the needs of students, as well as the level of mastery of previous students.

Learning mathematics is a process organized by the teachers to teach the students to acquire science and math skills. When we ask a student for expressing his opinion about learning math, then it will be a lot of complaints that sounds boring math lesson, not interesting, even too abstract, so that leads to the results of learning math. Teach mathematics is not easy due to the fact that the students experience difficulties in learning mathematics. To avoid those things, math learning should be based on the characteristics of the students.

III. HIGHER ORDER THINKING SKILL

Bloom's taxonomy is considered as the basis for the classification of thinking skills. In revised Bloom's taxonomy, analytic, evaluative and creative skills are categorized as *transferring* or processing which is part of higher order thinking skills while the ability to remember, to comprehend and to apply the learning are categorized as *recalling* which is part of lower order thinking skills [3].

The school's curriculum which focused to develop the human resources (HR) includes the cognitive, affective and psychomotor. Higher Order Thinking Skills is one of the resources so that knowledge and skills must be improved and developed. Therefore, one indication the improvement success of human resources in the education field are students have a high level of skill is good, because the primary purpose of learning in the 21st century is to develop and enhance the student's HOTS. Especially in the math lesson HOTS is one of the priorities of developed, following Permendikbud No 64 Tahun 2013 about standard contents for mathematical subjects stated that math needs to be given to all students ranging from elementary school to equip learners with the ability of logical thinking, analytical, systematic, critical and creative & ability of problem solving and teamwork.

However, based on the results of TIMSS written by Mullis.at.al (2012) the position of Indonesia on the domain of cognitive reasoning and domain content numbers each are on the last ranking and rating to 37 from 43 countries. This suggests that the ability of the learners on the low, so the reasoning needs to be improved by making the process of learning mathematics based HOTS. In addition, based on the results of the survey conducted Musfiqi [4] to 20 Junior high school mathematics teacher in Jepara regency, found that 75% of respondents initiated their math learning with the introduction of definitions and formulas without connecting it to solving problems in a variety of contexts. While it 90% of the respondents had never planned nor implement learning that emphasizes on thinking skills. As a result of students ' thinking ability has not been directed to the level of the higher thinking skills, including the ability to think critically and creatively in problem solving.

Based on the above facts, it can be concluded that the ability of higher-order thinking students remains relatively low; this is due to the HOTS have not applied in the process of learning mathematics processed. Therefore, the perceived need for a learning process oriented enhancement as well as granting HOTS questions based HOTS. In line with that, based on the principle of teaching from NCTM (NCTM, 2000, p. 20) "effective mathematics teaching requires understanding of what students know and need to learn and then give the challenge and support them to learn them well".

According to Bloom [5], Higher Order Thinking Skills is a process that involves mental, such as classification, induction, deduction, and reasoning. Stein and Lane [6] defines a high level thinking is the complex thinking, non-algorithmic thinking to solve a task in which there is not a predictable, well-rehearsed approach or pathway explicitly suggested by the task, task instruction, or a worked out example. According Stein, higher-order thinking using a complex thinking, non algorithmic to complete a task, there is that unpredictability, uses a different approach with existing tasks and different from the example. Higher-order thinking is the ability to complete tasks where there is no algorithm that has been taught, which require justification or explanation and have more than one possible solution [7]. High level thinking skills learners will produce: proficiency students in problem-solving strategies to become good, confidence level learners in mathematics increased, and the learning achievements of students in non-routine problem that demands high level thinking skills increase.

Mc Loughlin and Luca [8] state that HOTS means the ability to comprehend the information beyond what is given, to adopt critical disposition, to possess the meta-cognitive awareness, and to solve problems. HOTS is an ability to connect, manipulate, and transform knowledge as well as already possessed experience so as to think critical and creatively in order to decide for the necessary things to do and to solve problems in any new situations. According to Susan M. Brookhart [9], HOTS is classified into three categories. Those categories are which define HOTS as *transferring* in matter of critical thinking and in problem solving.

Based on the definition, higher order thinking skill leads to problem solving skill. According to Woolfook [10], problem solving skill is a skill of a student in directing his/her thoughts to solve problems through the gathering of facts, analysis of information, putting together the many alternatives of solving them, and selecting the way the most effective means to solve the problems. Thus, HOTS is a one's skill to criticize, to find solution to problems which are complex and to be able to give several alternative solutions over a certain problem by way of manipulating different information acquired. Human persons are not the only ones who can solve problems but solving problems is identical to human activities. On the basis of the opinions above, then it can be inferred a high level thinking skills is thinking skills at a higher level than just memorizing content and involve diverse thought processes of analyzing, evaluating and creating a conditioned in the process of mathematical problem solving.

According to Krathworl & Anderson in Arifin [11] Practice, indicators to measure higher-order thinking skills include: (1) analyze: (a) Distinguish (differentiating) include the ability to distinguish the parts of the overall structure of the form accordingly. Distinguish happens when students discriminate information relevant and irrelevant, what's important and not important and then pay attention to the information that is relevant and important. (b) Organize (Organizing) include the ability to identify the elements together into a structure. The process of organizing occurs when students build relationships a systematic and coherent (related) between pieces of information. (c) Attributing is the ability of students to mention about viewpoints, refraction, the value or the intention of concerns. (2) Evaluate: (a) Checking is the ability to test the internal consistency or error in operation or the outcomes as well as detect the effectiveness of the procedures used. (b) Criticize is the ability to decide the result or operation based on specific criteria and standards, and detect whether the results obtained on the basis of a procedure are approaching the correct answer. (3) Created: (a) Formulating hypothesis or make hypothesis, involves the process of describing the problem and make choices that meet certain criteria. (b) Planning process involves plan a method of settlement of an issue that is in accordance with the criteria of the problem. (c) Producing involves the process of implementing a plan to solve a problem that meets certain specifications.

Newman and Wehlage [12] state that HOTS require students to requires students to manipulate information and ideas by way of transforming their meaning and implications, such as when students combine facts and ideas in order to synthesize, generalize, explain, hypothesize, or arrive at some conclusion or interpretation. Realizing that knowledge is wide, with HOTS students will learn more profoundly and comprehend the concept better. This is definitely in accordance with substantial character of every subject when students are expected to be able to express their understanding over the matter with profundity. With HOTS, students will be able to differentiate ideas with clarity, to stand the arguments soundly, to solve problems, to construct due explanations, to hypothesize, and to comprehend complex matters clearly. HOTS is learnable, it can be taught to students, and with it, students' character can be formed accordingly. Furthermore it is said that there is indeed difference between rote learning with that of HOTS which applied higher order thinking. To think means to use one's analytical, creative, and applicable skills. This sort of thinking is what is needed in one's daily life.

It is also said that with HOTS students can become independent thinkers, hence the arguments uttered indicates the quality of his/her abilities. Applying HOTS as one of the means of learning leads to the productive learning especially in socio-cognitive interaction, such as: (1) giving and receiving help, (2) changing and completing information, (3) elaborating and explaining concepts, (4) sharing of knowledge with co-students, (5) mutual giving and accepting correction, (6) collaboratively doing assignments, and (7) rending necessary contribution in overcoming challenges. With the approach brought by HOTS, students are invited to actively think especially in the problem solving [13].

IV. MATHEMATICS REASONING

Learning school mathematics is assumed to be given to a student who never know mathematics before. According to Joyce and Well [14] that the teacher's duty in the learning process is to assist students to finding information, ideas, skills, value, way of thinking, as well as looking for good way of learning and express themselves. Having regard to learning's rule, teachers may be able to evoke right

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way to makes mathematics reasoning. In Permendikbud No.22 Tahun 2006; that students are expected to use reasoning, logical thinking, analytic, systematic, critical and creative in solving mathematical problems. Thus, the reasoning ability is one of important focus in learning mathematics, because if the students have not been able to reasoning, then they will difficult to solve the problems presented. Mathematics reasoning is not an ability that can be seen in a short time. Students, who are able to reasoning properly, usually trained in completing various forms of problems presented by teachers, both problems are simple to complex problems. Given the problems with the conditioning routine, non mathematical reasoning students will be expected to build and can be applied to the problems faced in the future.

Each student needs reasoning in order to achieve the desired learning objectives. Reasoning has not been clearly defined, but if makes hypothetical analytic reasoning means controlling and developing the thought of a thing until became clear. Then, when drawn in mathematical it is called mathematical reasoning. Mathematical reasoning is an ability to solve mathematics problems. There are five various types of mathematical reasoning, such that; 1) Algebraic reasoning, 2) Proportional reasoning, 3) Statistical reasoning, 4) Geometrical reasoning, 5) Probabilistic reasoning. Which all of those component are in learning school mathematics. When students are learning mathematics, teacher must be direct students to build their reasoning.

Walle [15] makes a conclusion that algebraic reasoning is ability to representing, generalizing and formalizing pattern and regularity in all aspect of mathematics. There are levels within learning algebra. Learning school mathematics is not always use abstract symbol, because teachers must be developing mathematics reasoning gradually. Lesh, Post, and Behr [16] claimed that proportional reasoning is ability to compare different comparison and mental ability to store and process the information pieces by using sensory. So, when students learn about ratio and they can compare all of different comparison, its mean students have a proportional reasoning. Sceaffer [17] stated that statistical reasoning is ability to solve mathematics problems related to corporate data, sampling and experimentation, anticipating patterns and statistical inference. Then Jeanette [18] says that “geometrical reasoning is the process defining and deducing the properties of a geometric entity using the intrinsic properties of that entity, its relationships with other geometric entities and the rules of inference that kind such properties together in geometric space”. The last of various types of mathematical reasoning is probabilistic reasoning. Have the same principle with statistical reasoning, probabilistic reasoning is ability to see pattern in data.

V. RELATION BETWEEN MATHEMATICS REASONING, HOTS AND STUDENTS CHARACTER

Students who give non routine mathematical problems in continue ways; will give the effect of improved thinking skill. Thinking improvement is characterized by the reason ability or gives reasons over the settlement they earn. This ability is called mathematics reasoning. Mathematics reasoning needs critical and creative thinking skills, which is both an indicator of higher order thinking skills. So it is understood that reasoning, critical and creative thinking skills are indicators of Higher Order Thinking Skill such as formulated by the Bloom that Higher Order Thinking Skills is a process that involves mental, such as classification, induction, deduction, and reasoning.

Thus, it is known that in order to improve high order thinking skills required learning mathematics with mathematical reasoning. But note that mathematical reasoning include analyze, differentiate, simplify, presenting and illustrating with accompanying reasons. And this would not be realized in learning just a few times, but it takes a long time to let those skills appear in students. The exposure of previously known that high level thinking skills can foster student’s character, it is seen from the student's persistence in solving mathematical problems presented by the teacher. To solve mathematical problems in diverse, it is not possible for students to find an alternative solution in short time, which could indicate towards a critical and creative. In the face of diverse mathematical problems, the non routine, students need quite a long time so that it will appear in the process traits of character that leads to students as thorough, diligent, sensitive, honesty, tolerance, caring, democratic, disciplined, hard working, independent, high curiosity, never give up, critical and creative.

VI. CONCLUSION

Higher Order Thinking Skills is a process that involves mental, such as classification, induction, deduction, and reasoning. And if we drawn in mathematics there are five various types of mathematical reasoning, such that; 1) Algebraic reasoning, 2) Proportional reasoning, 3) Statistical reasoning, 4) Geometrical reasoning, 5) Probabilistic reasoning. With mathematical reasoning, teachers can provide space for students to think logically in understanding mathematics concepts and consider all the possibilities that exist to solve problems. In the process of finding the solution of this problem, students will require unusual thinking skills are often referred to as higher order thinking skills. Improved way of thinking in the process of mathematical problem solving can build performance and moral student's characters such as discipline, honest, responsible; never give up etc. Because there are six pillars of character such that, 1) Trust, 2) Respect, 3) Responsibility, 4) Fairness, 5) Caring and 6) Citizenship. When learning mathematics that uses mathematical reasoning as one of focus learning can increasing higher order thinking skill. This can be achieved when in learning process; teachers provide opportunities for students to explore their ability. Then, with non routine problems, students will be used to looking for creative solutions, critically analyze, unyielding seek a proper, honest and tolerance in the difference solutions. And teacher's belief when provide an opportunity for their students can affect their moral characters, because students will find that their mathematics teacher is an open-hearted person. So, students will apply these characters in their life.

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Fostering Student's Higher-order Thinking Skill Through Problem-based Learning in Calculus

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***Abstract*—**Problem-based Learning (PBL) is one of recommended learning models in implementation of curriculum 2013. PBL provides opportunities for students to construct knowledge, and enhance their thinking skills through the filling of a problem as the starting point of learning process. Problems in PBL requires students to regain access to prior knowledge that lead students to think deeply. Thinking is infused in PBL when students plan, generate hypothesis, employ multiple perspective, and work through facts and ideas systematically. Problem resolution also involves logical and critical analysis, use analogies and divergent thinking, and creative integration and synthesis. Thinking Activities are needed by students, especially for understanding difficult math materials. One of math material that need student's thinking is calculus. It consist of limit, derivative, and integral of function. Not only a lot of students that have difficulties to learn calculus, but also teachers. They have difficulties in how to teach this material. Therefore, PBL is the most suitable method that can be an alternative to teach calculus. In conclusion, PBL activities in the classroom will foster student's higher-order thinking skill.

Keywords: *fostering, higher-order thinking skill, problem-based learning, problem, calculus*

I. INTRODUCTION

Inovation in education still held in every year to improve quality of learning activity. Improvement of learning quality purposed to solve all problems that faced, include Mathematics learning problems. One of inovation in education that had been done by government is evaluation of curriculum.

In 2013, Indonesian government decide new curriculum named curriculum 2013 for elementary and secondary school. Implementation of that curriculum can be seen in learning procces in the classroom. Learning procces of schools helds in interactive, inspirative, interesting, challenging, and motivated students to be active and give oppurtunities for their innovation,creativity, independece through their talent, interest, physically and psychology [11]. Paradigm that used in learning procces is constructivism [16]. So that learning models that used in learning procces based on constructivism paradigm.

Implementation of curriculum 2013 still has many problems. Most of teachers in indonesia have difficulties in impelementation curriculum 2013 [16]. The big problem that face is the lack of teacher understanding about the new curriculum [17]. In the other hand, learning quality in the classroom effects in improvement of student's thinking skill. Teacher as a designer must provide learning atmosphere that can be support improvement of sudents' thinking skill. Ideally, all students are provided high-quality instruction that offer the opportunity to learn the knowledge and skill [7]. In constructivist class, a teacher does not teach how to answer the questions, but presentated problem and encouraging students to find out their strategy in solve the problems.

According to Vygotsky, thinking skill growth from lower to high level. Learning material should be used as a tool to train student's thinking skill, not as a purpose [19]. Beside that, learning not only as rehearsing information and formulas/equation, but also how to use that information and knowledge to sharp the thinking skill. The learning environment should encourage students to engage in higher-order thinking activities [19]. Teachers need to move away from an over-emphasis on content mastery and adopt pedagogies that enable the development of thinking processes [15]. To foster student's higher-level thinking, teachers must possess not only in-depth subject matter knowledge in the field they are specializing in, but also good pedagogical knowledge on how to develop student's higher-order thinking –

both in the context of the subject matter they are dealing with and as a general skill [2]. Pedagogical knowledge include learning models based on the purpose in curriculum.

One of learning model that recommended in implementation of curriculum 2013 is Problem-based learning [16]; [10]. Problem-based learning (PBL) is learning that use problem as starting point of learning procces [21]. “Problem-based learning has been shown to actively engage students in relevant learning experiences” [1]. Student’s activities in problems-based learning, can help them to build their thinking skills and problem solving. effort to encourage student’s higher-order thinking skill that have positive effect in increasing motivation and achievement [4]. In short, problems that pose in learning process can help students to construct their knowledge and find out the concept through problem solving process.

Students need thinking activities to understanding the difficult learning material in mathematics. One of the difficult material is calculus [20]; [3]. Not only a lot of students that have difficulties to learn calculus, but also teachers. They have difficulties in how to teach this material. To solve the problems, learning by using PBL model can be used as an alternative. Many finding of researches was suggested teachers to use PBL in learning mathematics to improve student’s thinking skill. PBL in calculus course improve student’s critical thinking, evaluative and judgment/making decision [13]; [9]. Therefore, adopting PBL method in learning process, teacher can create a number of creative thinkers, critical decision makers, problem solvers which is very much needed for the competitive world.

II. LITERATURE REVIEW

A. Problem-based Learning

Problem-based learning (PBL) is a student-centered approach that organizes curriculum and instruction around carefully crafted “ill-structured” and real-world problem situations [1]. PBL focus on problem use as starting point in learning process [21]. Problem-based instruction describes a learning environment where problems drive the learning. That is, learning begins with a problem to be solved, and the problem is posed such a way that students need to gain new knowledge and skill before they can solve the problem[18]. PBL is recognized as a progressive active-learning and learner-centered approach where unstructured problems (real-world or simulated complex problems) are used as a starting point and anchor for the learning process [21]. It can be conclude that problem-based learning (PBL) is learning model that student-centered and use contextual, complex, ill-structured problems as starting point learning process. PBL process not only oriented in finding solution of the problems, but also problem solving process it self and help them to find the concept.

PBL activities in the classroom involve design of problems and organize of students. Every step of PBL required students be active in that activity. Problem-based learning (PBL) in the classroom includes the following steps. Tan [22] suggest five steps: (1) meeting the problem; (2) problem analysis and learning issues; (3) discovery and reporting; (4) solution presentation and reflection; and (5) overview integration and evaluation. Arends and Kilcher [1] suggest five steps: (1) orient students to the problem; (2) organize students for study; (3) assist independent and group; (4) develop and present artifacts and exhibits; and (5) analyze and evaluate the solving process. Beside that, Eggen and Kauchak [6] suggest four steps: (1) review and present the problems; (2) define strategy; (3) implement the strategy; and (4) examine and evaluate solution. According to some opinion above, we can see that PBL activities in the classroom include: (1) present the problems; (2) organize students for study; (3) identification and formulation the problems; (4) investigate and problem solving; (5) solution presentation presentasi; and (6) evaluate and making conclusion.

Teacher’s roles in PBL are design the problems, facilitate, and mediate students in learning process. Teachers do not give subject material but motivated and facilitated students by giving problems. In problem-based learning, complex and real-world problems are used to motivate students to identify and research the concepts and principles they need to know to work through those problems [5]. In PBL, students are given the opportunity to find knowledge for themselves and to deliberate with other. They then refine and restructure their own knowledge with new knowledge and experiences. Therefore PBL in the classroom is not only about infusing problems into the class but also about creating opportunities for students to construct knowledge themselves. Fig. 1 shows shift of learning paradigm from traditional model that focused on learning material to be learning that focused on problems by using problem-based learning (PBL).

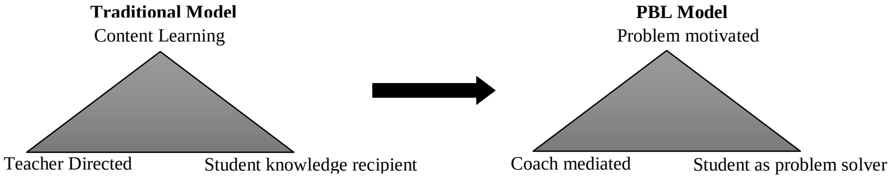

FIGURE 1. SIFT OF LEARNING PARADIGM FROM TRADITIONAL TO BE PBL

Paradigm that used in PBL appropriate with curriculum 2013. There are 14 points suggested in learning process based on this curriculum. Several of learning process that suggest in that curriculum accommodate in PBL. there are learning that from students be informed about concept, to be students to find out, from teacher as the only one learning source to be learning with many sources, from learning based content to be learning based competence, and from learning that suggest one solution/answer to be multi solution [11].

B. Facilitating Higher-order Thinking Skill in PBL Process

Here are techniques to foster student's higher-order thinking skills through learning activities in the classroom. These techniques are related with teaching strategies. Musfiqi and Jailani advise that to improve the higher-order thinking skills (HOTS) of students, the teacher's role as facilitator should be noticed [14]. Moreover, Protheroe [8] suggested that a mathematics classroom must do the following things to achieve an effective environment for higher-order thinking: (1) actively engage in doing mathematics; (2) solve challenging problems; (3) make interdisciplinary connections; (4) share mathematical ideas; (5) use multiple representations to communicate mathematical ideas; (6) use manipulative and other tools. Beside that, Upon studying the effects of varying instruction for high school math and science students, Miri, David, and Uri [12] proposed the following three teaching strategies for generating higher-order thinking skills: (1) present real-world cases–encourage students to cope with relevant situations; (2) direct class discussions related to a concept/phenomenon or a problem–encourage students to ask questions and present their own solutions; and (3) guide short inquiry-type experiments in groups–encourage students to learn in cooperation.

Thinking is infused in PBL when students plan, generate hypothesis, employ multiple perspective, and work through facts and ideas systematically. Problem resolution also involves logical and critical analysis, use analogies and divergent thinking, and creative integration and synthesis. One of strategy that can be used by teachers in PBL is the questioning method. Questions aim to help students through each step in the PBL activity. Many researchers have proposed using probing techniques or questioning methods to enhance thinking in students. Asking higher-order questions has values in helping students to develop their thinking skills Wetzel [8] proposes using the following examples as questions that probe the individual toward higher understanding: (1) what additional information do you need to solve the problem?; (2) how does the data relate to your findings?; (3) how does the evidence support your conclusions?; (4) what would you need to do to determine if this solution is true?; (5) how can you compare this with other problems?. These questions can be given from the beginning until the end of learning process. Table 1 show the list of the questions that can be used to facilitate student's thinking skill in PBL activities.

TABLE 1. QUESTIONS LIST TO FACILITATE HOTS IN PBL ACTIVITIES

PBL Activities	Question
Identification and formulation the problems	• What the meaning of limit on that problem? • What being approximate? • Is the value of f(x) around x = c can be define? • Why the value of f(x) at x = c does not exist? • What are the differences tangent line and secant line? • What additional information do you need to solve the problem?
Investigate and problem solving	• Is the limit of function can be define by using method…? • Why limit of that function can not be define by method…? • Is the problem can be solving by using method…? • Is the other ways more effective?
Evaluate and making conclusion	• How about the limit of function… if the value of x is change with approximate with….? • Write two or more problem that can be define by using our concepts. • What would you need to do to determine if this solution is true? • How can you compare this with other problems?

III. CONCLUSSION

Based on the description above, it can be concluded that PBL activities in learning calculus class will foster student's higher-order thinking skill. Beside that, to be more effective in PBL activities, teacher's role as a facilitator should be noticed In addition, the use of PBL in teaching calculus must be supported with these kinds of problems presented in each of the learning process.

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ME – 20

The Student' Models For The Meaning And Procedure Of Multiply Two Fractions

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Abstract—Lortie-Forgues, Tian and Siegel (2015) suggests that students' understanding of the fractions is very important in the study of mathematics further and are also used in many professions, but according to Lortie-Forgues, Tian and Siegle (2015) and MA (1999), many students have great difficulty in understanding it. Furthermore, according to Ma (1999), the difficulty is not only the difficulties experienced by students in learning fractions, but also the difficulties experienced teachers to teach the concept of fraction. It was felt by teacher at one of the private elementary school in Yogyakarta, especially in teaching multiplication on fraction. The goals of this study were (1) finding the student'model that could be constructed when they learnend about the meaning and procedure of multiplication between an integer and a fraction, and (2) finding the student'model that could be constructed when they learnend about the meaning and procedure of multiplication of two fractions. There were two contexts used by the researchers in this study that is buying the ribbon and giving oranges. Lesson plan created by the researcher were for students of grade five. There were six models of multiplication between an integer and a fraction that could be constructed by students using that context. There were four models of multiplication of two fractions that could be constructed by students using that context. This type of research used by the researchers in this study was the design research developed by Gravemeijer and Cobb. According Gravemeijer and Cobb (in Akker, Gravemeijer, McKeney, and Nieveen, 2006) there are three phases in the research development, namely (1) the preparation of the trial design, (2) test the design, and (3) the retrospective analysis.

Key Words: *the multiplication of fractions, realistic mathematics education (RME), and design research.*

I. INTRODUCTION

In 2013 and 2014, the researcher developed some context and sequence of learning that can be used to teach the fractional multiplication in grade five of the elementary school. From the experience of two years, the researcher wanted to try to develop another context that will be used to teach the multiplication of the fraction in grade five of the elementary school. In this year, the researcher had the opportunity to develop and provide context about buying the ribbon, and giving oranges. The researcher also got the opportunity to pilot the lesson plan in one class on grade five in a private elementary school in Yogyakarta. In this paper, the researcher would present the student'models that could be built by students when problems were built with the context given to students.

Lortie-Forgues, Tian and Siegel (2015) suggests that students' understanding of the fractions is very important in the study of mathematics further and are also used in many professions, but according to Lortie-Forgues, Tian and Siegle (2015) and MA (1999), many students have great difficulty in understanding it. Furthermore, according to Ma (1999), the difficulty is not only the difficulties experienced by students in learning fractions, but also the difficulties experienced teachers to teach the concept of fraction. There were several studies that have been done related to fractions which explains why fractions into one material that is difficult to understand by students, namely:

1. According to Lamon (2001, in Ayunika, 2012), the development of understanding of the meaning of fractions in the teaching-learning process was a complex process because the concept of fraction had a

number of interpretations, namely (1) fraction as a part of the whole, (2) fraction as the result of a measurement, (3) fraction as an operator, (4) fraction as a quotient, and (5) fraction as a ratio.
2. According to Ross and Case (1999 in Shanty, 2011), on the process of learning fractions, teachers often emphasize on how to do the operation procedure than on the meaning of the operation.
3. Stafylidou dan Vosniadou (2004 in in Shanty, 2011) states that one of the reasons why the idea of mathematical fractions are systematically misinterpreted by students is an inconsistency with the principles of arithmetic used in operations involving natural numbers. For example in the operation of multiplication of natural numbers, if the two natural numbers multiplied, then the multiplicative result is a natural number greater than or equal to two natural numbers are multiplied. It was not always the case if the two fractions multiplied.
4. According Streefland (1991), in many textbooks the instruction of fractions is characterized by:
   a. Towards the concept of fraction.
   b. There are not meaningful contexts both as sources and domains for the application of fractions.
   c. The isolated use of models and patterns, which never extends to serve the process of algorithmization or mathematization.
   d. There are not connections with mathematically domains, such as decimal fractions, ratios, scale, and percentages (Vergnaud, 1981).
   e. Towards the algorithms.

There were two questions that will answer in this paper, namely (1) what were the student'model that could be constructed when they learnend about the meaning and procedure of multiplication between an integer and a fraction? and (2) what were the student'model that could be constructed when they learnend about the meaning and procedure of multiplication of two fractions?

II. THEORETICAL FRAMEWORK

The philosophy of RME was mathematics as a human activity, which means that the learning process of mathematics first of all should not be connected with mathematics as a deductive system that was well organized and formal, but it should be connected with mathematics as a human activity (Freudenthal, 1971, 1973, in Gravemeijer, 1994). If the mathematics which was learned by the student was connected with a formal deductive system, then the student will view that mathematics was resulted by the human thinking; it was an abstract and was not related to real-life. So, they will think that they could not find mathematics and using mathematics in their life. Learning mathematics should be able to make the students thought that there was mathematics in human activities, and it was be used by them in real life.

There are four main principles in the RME (Gravemeijer, 1991 and 1994, Treffers, 1991, and Julie, 2014), namely:

1. Guided reinvention;

According to this principle, students were given the opportunity to be able to reinvention both concepts and procedures in mathematics, "like" the mathematicians to find it. In the reinvention process was done by the students, in addition there was the teacher guidance, there needs to be a student communication, and there was a negotiation process between one student and other students. The communication and negotiation process between one student and other students were intended to develop students' findings gradually until the students can achieve the mathematics formal knowledge.

2. The progressive mathematizing;

In RME, students learned to construct a formal mathematical knowledge through to solve the contextual problem series. In RME, this process is known as the mathematizing process. Students were expected to experience the development in every stage of problem solving from one problem to other problems. This development was happen in the translating problem and in the retranslating solution of the problem. The problem solving process evolved from informal strategies to more formal procedures. In the end, the solution for a kind of the problem becomes routine. In other words, the solution procedure on the similar problem can be simplified further and formalized through the problem series, so that at the end, a formal procedure can be found by students. Through this learning process, a formal mathematical knowledge can be reconstructed by themselves. This process is illustrated in figure 1. In the RME, this process is called a progressive mathematization.

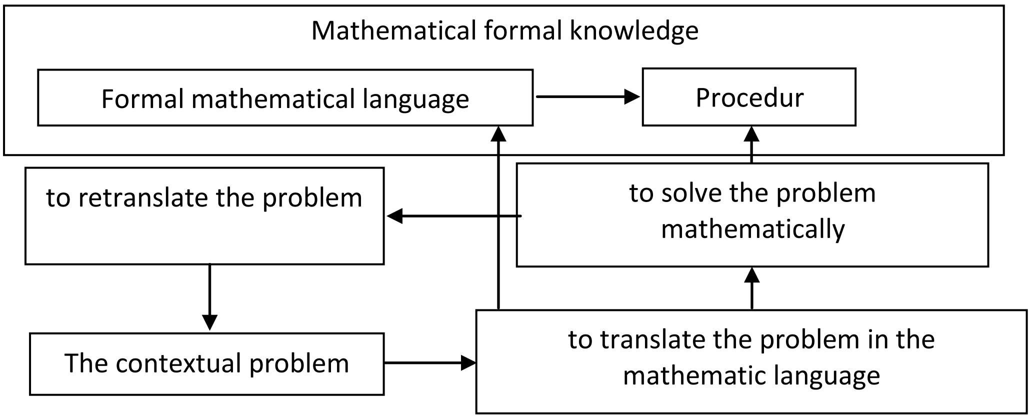


Figure 1: The reinvention process through the progressive mathematization process

3. Didactical phenomenology;

The students were given the opportunity to explore phenomena or situation series that can make students experience the process of establishing a formal mathematical knowledge in a sustainable manner. The purposes of the investigation of the phenomenon by students were to investigate the circumstances that approach to the particular phenomenon, and the results of the investigation can be generalized to generate solution procedures, so it would develop the formal mathematical knowledge.

4. Self-developed models.

In RME, models were interpreted as a representation of translating problems into the mathematics language and problem solving in the problem solving stages. A model in RME may involve a model of a situation, schematics, descriptions, or a way to express an idea or ideas. The modeling process by students played the role as a bridge between the informal and formal mathematical knowledge. In RME, the models must be built by themselves as a result of the exploration of the phenomenon by the students and the basis for forming a formal mathematical knowledge. It means that students should be given the opportunity to build models when the problem solving process was occured.

When teacher seek to build the formal mathematical knowledge of students, teacher need to do with the bottom-up approach. First, a model was related to real life activities, and it was called the **situational model**. After that, a model was a model of the specific context, and the model obtained in this way is termed **model of**. Then, the model was generalized to many similar situations, and the model was constructed in this way is termed the **model for**. At the end, the model becomes something truly lies within students, and can be used as a basis to achieve a formal knowledge of mathematics and it was called the **formal model**.

III. RESEARCH METHODOLOGY

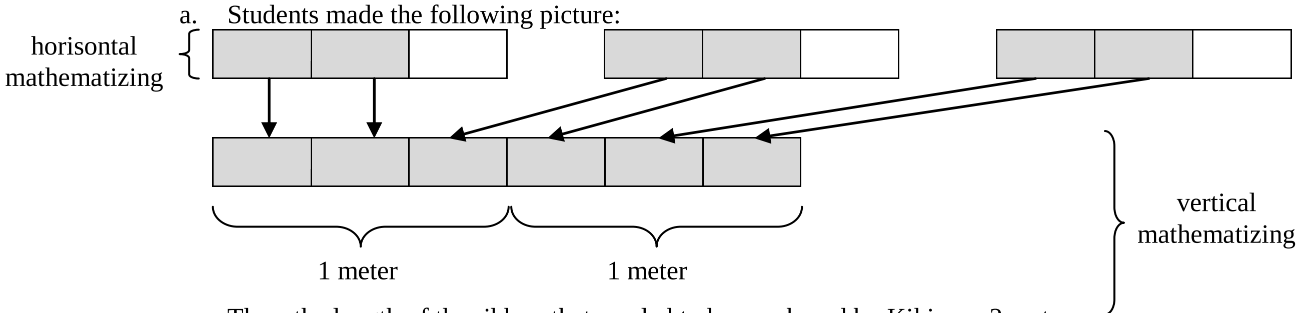
The approach used to develop the students' learning materials and the teacher guide in this research activity was RME. This type of research that was used by the researcher in this study was the design research with three cycles. Things that were presented in this paper what was done by the researcher and what comes out of the third cycle. The data analysis was conducted by video data and the student's work. The steps undertaken by the researcher followed the phases in the development research were developed by Gravemeijer and Cobb.

IV. RESULTS

The research results presented in this paper were limited by the researcher on the third cycle. The aims of the design that was made by the researcher were that students could know about (1) the meaning and the procedure of the multiplicaton between an integer and a fraction, and (2) the meaning of multiplication of two fractions and the fractional multiplictation procedure. Before students experienced learning process designed by the researcher, students have learned about fractions in grade four, namely (1) the meaning of fractions, (2) the ordering of fractions, (3) the simplfying of fractions, and (4) the additing and subtracting of fractions. The problems were given to students inspired by the problems that exist in the book that written by Fosnot, and Dolk (2002) and the teacher' idea who taught the students in grade five.

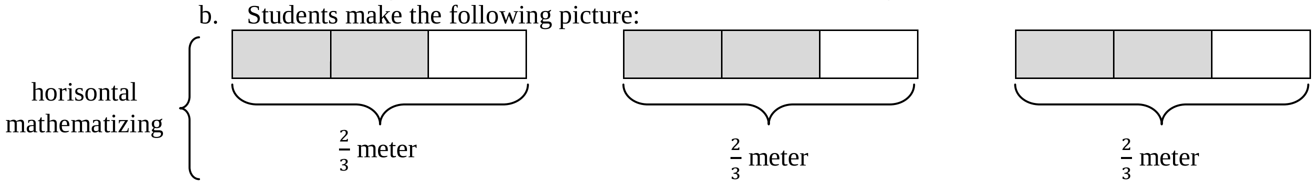
Here was presented problems that were given to students, and the student'model about (1) the meaning and the procedure of the multiplicaton between an integer and a fraction, and (2) the meaning of multiplication of two fractions:

1. **The problem was given to students:**
   Kiki needed 3 pieces of ribbon for the gift decoration.
   The length of each ribbon was needed Kiki is $\frac{2}{3}$ meter.
   To fulfill the needs of a ribbon, Kiki would purchase the ribbon.
   How many meters of ribbon were to be purchased by Kiki?
   The Student'models:
   a. Students made the following picture:



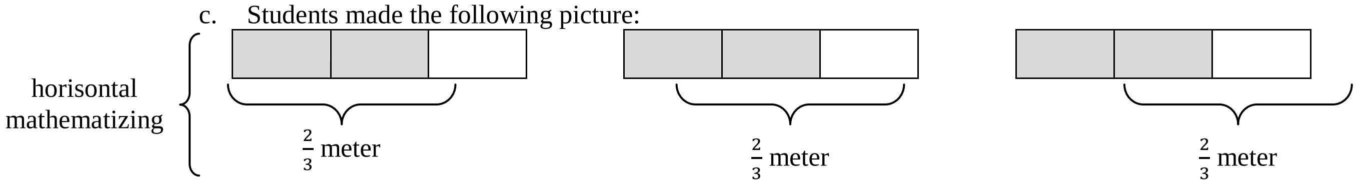
   Thus, the length of the ribbon that needed to be purchased by Kiki was 2 meters.

   b. Students make the following picture:



   Students then made the following calculations: $\frac{2}{3}+\frac{2}{3}+\frac{2}{3}=\frac{2+2+2}{3}=\frac{6}{3}=2$. This step was vertical mathematizing.
   Thus, the length of the ribbon that needed to be purchased by Kiki was 2 meters. This step was hisontal mathematizing.

   c. Students made the following picture:



   Students then made the following calculations: $\frac{2}{3}+\frac{2}{3}+\frac{2}{3}=3\times\frac{2}{3}=\frac{3\times 2}{3}=\frac{6}{3}=2$. This step was wertical mathematizing.
   Thus, the length of the ribbon that needed to be purchased by Kiki was 2 meters. This step was horisontal mathematizing.

   d. Students made the following calculations: $\frac{2}{3}+\frac{2}{3}+\frac{2}{3}=\frac{2+2+2}{3}=\frac{6}{3}=2$. This step was wertical mathematizing.

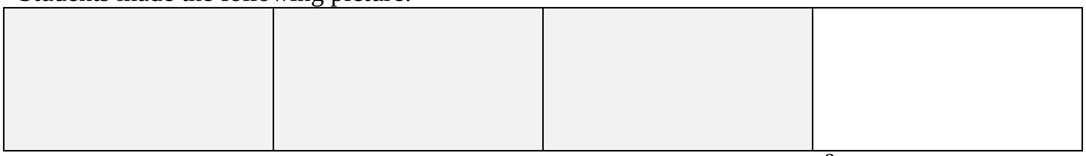
   e. Students made the following calculations: $\frac{2}{3}+\frac{2}{3}+\frac{2}{3}=3\times\frac{2}{3}=\frac{3\times 2}{3}=\frac{6}{3}=2$. This step was wertical mathematizing.

   f. Students made the following calculations: $3\times\frac{2}{3}=\frac{3\times 2}{3}=\frac{6}{3}=2$. This step was wertical mathematizing.

2. **The problem was given to students:**
   Gofil had $\frac{3}{4}$ kg of oranges.
   Gofil gave half part of oranges owned to Berto.
   How many kg of oranges would be given by Gofil to Berto?
   The Student'models:

horisontal mathematizing

a. Students made the following picture:

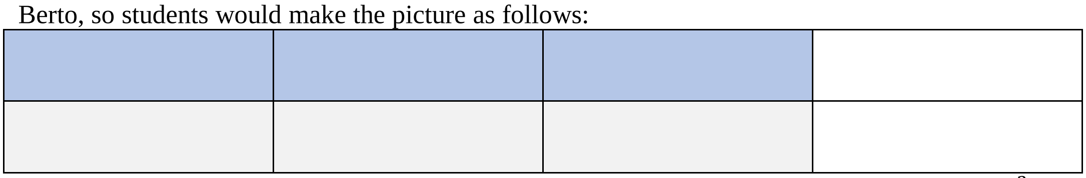


The gray shaded area was the heavy of the orange that owned by Gofil, i.e. $\frac{3}{4}$ kg.

horisontal mathematizing

Then, students shore the Gofil' orange into two equal parts. Students would get half part of the Gofil'orange. Students would make the following picture:

Then, students shaded with different colour to show the half part of the Gofil's orange given to Berto, so students would make the picture as follows:

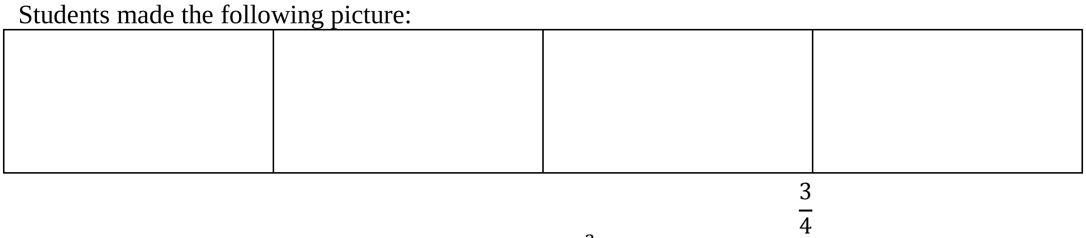


vertical mathematizing

1) The blue shade indicated the area of the Gofil'orange given to Berto, that is equal to $\frac{3}{8}$ kg. Because there were 3 blue shade parts of 8 parts of a whole.
2) The blue shade indicated the area of the Gofil'orange given to Berto, that is equal to $\frac{1}{2}$ part of $\frac{3}{4} = \frac{3}{8}$ kg. Because there were 3 blue shade parts of 8 parts of a whole.

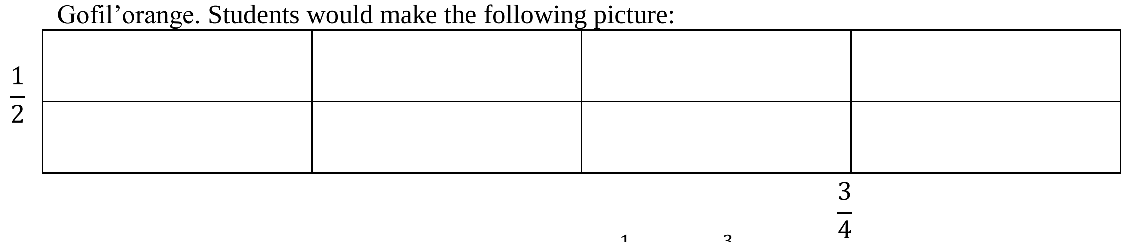
horisontal mathematizing

b. Students made the following picture:



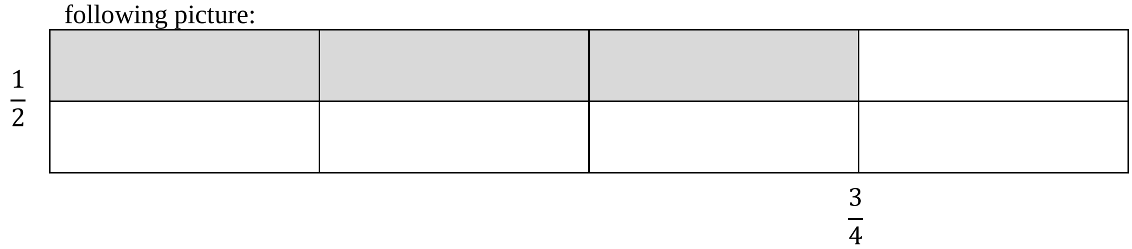
Students annotate the boundary area that showed $\frac{3}{4}$, so the weight of the Gofil' orange was represented by the left area of the boundary.

Then, students shore the Gofil' orange into two equal parts. Students would get half part of the Gofil'orange. Students would make the following picture:



Students annotate the boundary area that showed $\frac{1}{2}$ part of $\frac{3}{4}$ kg, so half of the Gofil 'orange weight was represented by the upper area of the boundary.

Then, students shaded to indicate the area of Gofil'orange given to Berto, as shown in the following picture:



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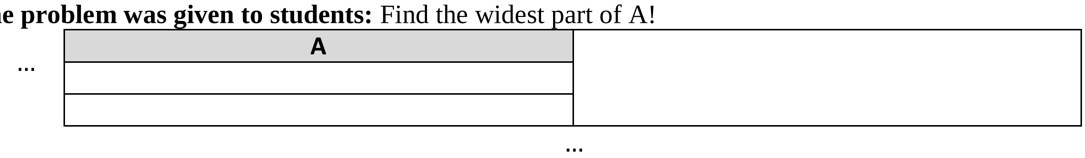
vertical mathematizing

1) The gray shade indicated the areas of Gofil'orange given to Berto, that is equal to $\frac{3}{8}$ kg. Because there were three blue shade parts of eight parts of a whole.
2) The gray shade indicated the areas of Gofil'orange given to Berto, that is equal to $\frac{1}{2}$ part of $\frac{3}{4} = \frac{3}{8}$ kg. Because there were 3 blue shade parts of 8 parts of a whole.

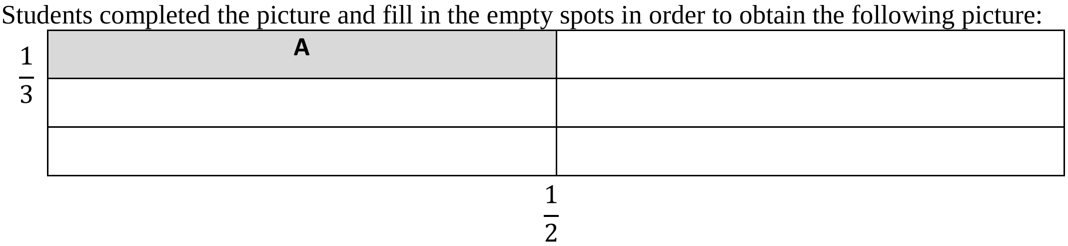
3. **The problem was given to students:** Find the widest part of A!



The Student'models:

horisontal mathematizing

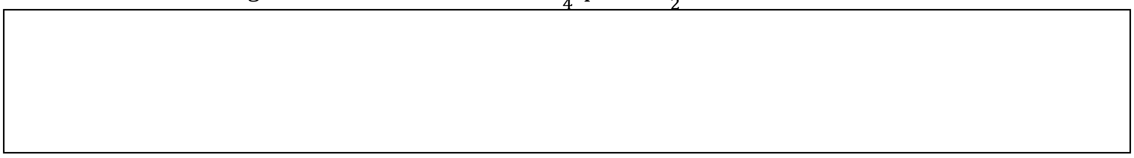
a. Students completed the picture and fill in the empty spots in order to obtain the following picture:



vertical mathematizing

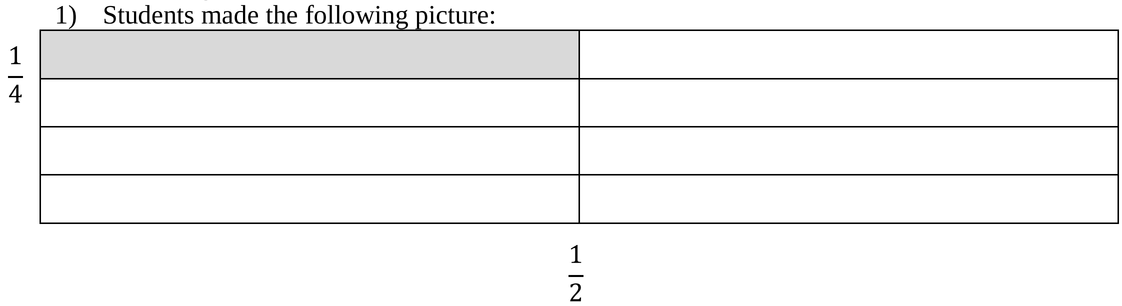
b. Then, students made calculation to find the widest part of A, i. e.:
   1) Students calculated, the widest part of A = $\frac{1}{3}$ part of $\frac{1}{2} = \frac{1}{6}$.
      Because there was one gray shade part of six parts of a whole.
   2) Students calculated, the widest part of A = $\frac{1}{3}$ part of $\frac{1}{2} = \frac{1}{3} \times \frac{1}{2} = \frac{1 \times 1}{3 \times 2} = \frac{1}{6}$.
   3) Students calculated, the widest part of A = $\frac{1}{3} \times \frac{1}{2} = \frac{1 \times 1}{3 \times 2} = \frac{1}{6}$.

4. **The problem was given to students:**
   Use the follow rectangle to illustrate the statement $\frac{1}{4}$ part of $\frac{1}{2}$ and calculate the results.

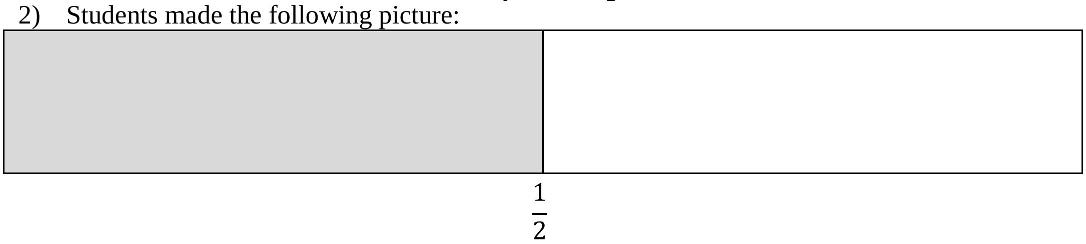


The Student'models:

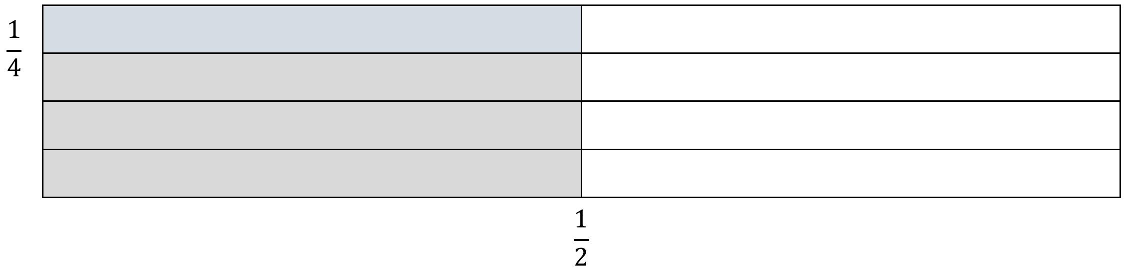
a. The possible answers were made by the student to describe $\frac{1}{4}$ part of $\frac{1}{2}$. This step was horisontal mathematizing.
   1) Students made the following picture:



   Students stated that the shaded area was $\frac{1}{4}$ part of $\frac{1}{2}$.
   2) Students made the following picture:

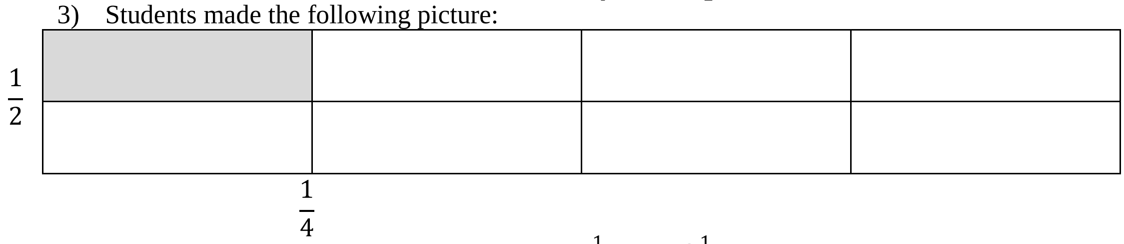


Students stated that the gray area shaded was $\frac{1}{2}$.
After that, the students subdivide the rectangle to obtain the following picture:



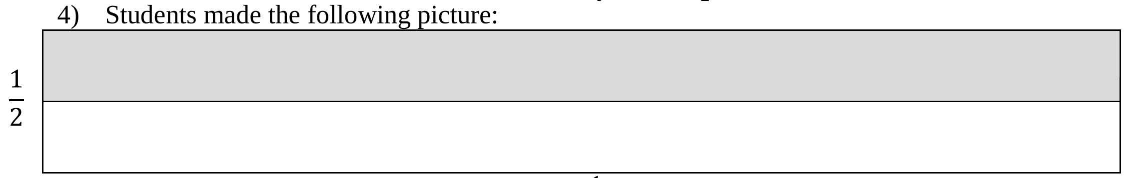
Students stated that the blue shaded area was $\frac{1}{4}$ part of $\frac{1}{2}$.

3) Students made the following picture:

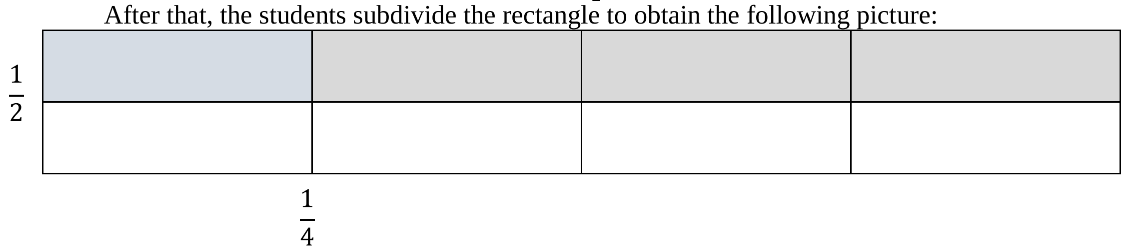


Students stated that the gray shaded area was $\frac{1}{4}$ part of $\frac{1}{2}$.

4) Students made the following picture:



Students stated that the gray shaded area was $\frac{1}{2}$.
After that, the students subdivide the rectangle to obtain the following picture:



Students stated that the blue shaded area was $\frac{1}{4}$ part of $\frac{1}{2}$.

b. Then, to calculate the amount of $\frac{1}{4}$ part of $\frac{1}{2}$, the possibility undertaken by students were as follows: (this step was vertical mathematizing)
   1) Studensts answered $\frac{1}{4}$ part of $\frac{1}{2} = \frac{1}{8}$. Because there was one gray shade parts of 8 parts of a whole.
   2) Students calculated that $\frac{1}{4}$ part of $\frac{1}{2} = \frac{1}{4} \times \frac{1}{2} = \frac{1 \times 1}{4 \times 2} = \frac{1}{8}$.
   3) Students calculated that $\frac{1}{4} \times \frac{1}{2} = \frac{1 \times 1}{4 \times 2} = \frac{1}{8}$.

5. **The problem was given to students:** calculate the follow multiplication $5 \times \frac{3}{7}$.
   The Student'models:

vertical mathematizing
   a. $5 \times \frac{3}{7} = \frac{3}{7} + \frac{3}{7} + \frac{3}{7} + \frac{3}{7} + \frac{3}{7} = \frac{3+3+3+3+3}{7} = \frac{15}{7} = 2\frac{1}{7}$.
   b. $5 \times \frac{3}{7} = \frac{5 \times 3}{7} = \frac{15}{7} = 2\frac{1}{7}$.

6. **The problem was given to students:** calculate the follow multiplication $\frac{5}{6} \times \frac{12}{15}$
   The Student'models:

vertical mathematizing
   a. $\frac{5}{6} \times \frac{12}{15} = \frac{5 \times 12}{6 \times 15} = \frac{60:30}{90:30} = \frac{2}{3}$.
   b. $\frac{5}{6} \times \frac{12}{15} = \frac{5}{6} \times \frac{4}{5} = \frac{5 \times 4}{6 \times 5} = \frac{20:10}{30:10} = \frac{2}{3}$.

V. CONCLUSIONS

The student learning materials has been tried out on students in the 5th grade at a private elementary school in Yogyakarta. The results of the trial were as follows:

1. Kiki problem could lead students to develop the situational model on the meaning of multiplying an integer by a fraction and on the calculation of multiplying an integer by a fraction.
2. Gofil' orange problem could lead students to develop the situational model on the meaning of multiplying two fractions and the calculating two fractions.
3. The problem about calculating $5 \times \frac{3}{7}$ could lead students to develop the formal model on the meaning of multiplying an integer by a fraction and on the calculation of multiplying an integer by a fraction.
4. Problem (a) seek the widest part, (b) describe and calculate the results of the $\frac{1}{4}$ part of $\frac{1}{2}$, and (c) calculating $\frac{5}{6} \times \frac{12}{15}$ could lead students to develop the situational model on the meaning of multiplying an integer by a fraction and on the calculation of multiplying an integer by a fraction.
5. The context of the Kiki' ribbon and the Gofil'orange could help students to construct about (a) the meaning and the procedure of multiplication of an integer and a fraction, and (b) the meaning and the procedure of multiplication of two fractions.

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ME – 21

Hypnoteaching Method to Foster Self - Belief of Primary School Students in Learning Math

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Abstract**—** The aim of writing this article is to examine theoretically related to the use of hypnoteaching method in growing self-belief of primary school students in mathematics Self-belief is one of important affective aspects that human has in living and dealing with challenge. Self-belief can encourage confidence, interest, motivation and optimism in everyone. It implicates for people's success in reaching their desire. In the process of mathematics learning in the classroom, self-belief becomes a connection for establishing a student's knowledge. However, to cultivate the students' self-belief in the mathematics learning is not easy, because the students' mind sets negative thinking or pessimistic of their success in learning mathematics. Therefore, the teacher as an important factor in the learning process should be able to determine an appropriate learning method to minimize the occurrence of these problems. If we browse the characteristic of primary school students, the hypnoteaching learning model could be one of the solutions in order to foster students' self-belief. Hypnoteaching is a learning method that presents the learning material through the subconscious has a great influence on the brain system. In addition, hypnoteaching can also foster students 'self-belief in learning mathematics. Thus, if self-belief has become a part of the students, it will have a positive impact not only in teaching process but also in the daily activities to face global competition.

Keywords: *Hypnoteaching Method, Self-belief,Primary School, Learning Math*

I. INTRODUCTION

Mathematics is one of the subjects that provide a range of benefits in life. However, this rationale does not make mathematics being loved by the students; rather it is a subject that the students afraid of because it is regarded as a lesson that only consist of numbers and formulas. This view makes students' mathematics learning achievement tend to be low. This is supported by the results of PISA 2102 [1] which depicts the students' ability of the Mathematics in Indonesia is on the ranking 64 of the 65 participants. One factor affecting students' achievement is belief or confidence of students in mathematics and mathematics learning.

Self-belief or self-confidence is believed as one of the very important affective aspects for someone to have in living and dealing with something challenging. Self-belief can boost self-confidence, interest, motivation and optimism that implicate to the success in reaching the desired objectives. Similar to mathematics learning, self-confidence has a positive role in order to improve students' achievement. False beliefs, such as making mathematics as a difficult lesson, which filled with numbers and formulas, as well as the abstractness, will have an impact on lower educational achievement. It would be different if the students have a good belief, then implications of course are to the good learning achievement. This is supported by research conducted by Perkins, Adams, Finkelatein & Wieman [2] concluded that there is a positive correlation between students' belief and conceptual learning. Additionally, Eleftheories & Theodosios [3] said that there is a positive correlation between a strong belief and the capabilities and good mathematics performance.

In realizing this, the teacher as the subject of learning designer has a very important role. Teacher should be able to change students' belief of mathematics which said that mathematic is regarded as a difficult subject into an easy mathematics lesson as well as it is beneficial to them. In the process of accommodating this goal, teachers need the ability to select and sort out the proper strategies, approaches, and method in learning mathematics.

In line with the characteristics of elementary school which is contextual math-based learning, then one of the teaching methods that are capable of supporting the learning of mathematics is hypnoteaching method. This method focuses on positive communication uttered by a teacher, who influence the students' subconscious, therefore students will follow what the teachers say and concentrate on learning. By doing so, students will acquire and store knowledge presented by the teacher easily. In addition, Hajar [4] revealed that hypnoteaching has an important role in enhancing confidence in the learning process in the classroom.

Due to the big influence of the students' self-belief to increase their mathematics achievement and the relevance of Hypnoteaching methods to cultivate students' self-belief, then this article will discuss about " Hypnoteaching Method to Foster Self - Belief of Primary School Students in Learning Math".

II. DISCASSION

A. The Characteristic of Mathematics in Elementary School

Mathematics School is not same to pure mathematics studied in university since both have different paradigm. Mathematics school is form of mathematics application concretely that relates to student's life. However, pure mathematics is built on definitions, axioms which become theorems.

Atkinson (Uno) [5] said that mathematics as a structured science, the learning process has to be done systematic, consecutively, and logically depending on student's intellectual development. Having same opinion, Piaget (Uno) [5] explains that primary students will get a concrete mathematics which the proportion depends on the grade, the higher a grade, the more abstract the material.

Ebbutt and Straker (Marsigit, Ilham & Nila) [6] suggest that the mathematics school essence is as (1) an activity of the investigation of pattern or relation (2) an activity of problem solving (3) an investigation activity (4) communication. The essence is nowadays regarded as the alternative to make mathematics as a friendly and pleased subject for students.

Mathematics learning for primary school must be designed interesting that is appropriate for student's cognitive development. Primary school students are still interested in concrete object. Therefore, the mathematics learning process needs an instrument that is media, and model to make what teachers said clear (Heruman,) [7]. According to Piaget (Yusuf) [8], the age of primary school is the end of the children think imaginatively and starts to think logically (relates to the reality). The period is signed by three new abilities, those are clarifying, arrange, or associate the number or symbol. The ability is related to counting like adding, subtracting, multiplying, and dividing.

Finally, we can conclude that mathematics learning process in elementary school has to be done based on concrete things that are around student's life that is appropriate to student's cognitive ability. Therefore, to make the purpose come true, the teachers have to be able to choose and manipulate every media around students learning place to become visual symbol instrument, fact, concept or principle in mathematics.

B. Hypnoteaching Method

Nowadays, many methods, approaches, or strategies the teachers use in learning process to achieve learning purpose. One of the methods that starts to be developed is hypnoteaching.

Hypnoteaching is the development of hypnotism. The word 'hypnoteaching' consists of two syllables, those are hypno and teaching, means as a learning method that uses hypnotism techniques in learning process (Pertiwi) [9]. Nurcahyono (Hajar) [5] suggests that hypnoteaching is an art to communicate by giving power to the students so that the students develop their thinking ways.

Hypnoteaching is a learning method where in the learning process, the teachers use subconscious languages that can grow students interest (Yustisia) [10]. In hypnoteaching, human's mind is divided by three parts that relate each other, those are subconscious mind, critical factor, and conscious mind. The following paragraph is the relation of human's mind part (Pertiwi) [9]:

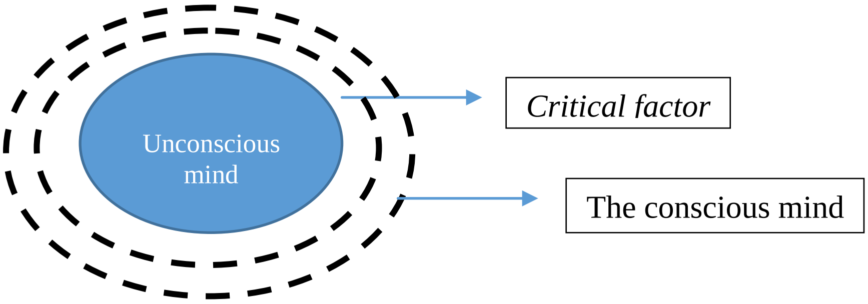

FIGURE 1. BRAIND COMPOSITION

The conscious mind is a mental process which students are in a fully conscious state. In this condition, the students put more emphasis on the process of realistic thinking or according to the ratio of their thinking. The conscious mind has the analysis function to all incoming information, accommodates incoming information and decides on a new piece of information used. The conscious mind has the effect of approximately 10-15% of all aspects of life, such as mindset, attitude, personality, and behavior. Meanwhile, the subconscious mind is a mental process that leads students in a half-conscious thinking process. The subconscious mind is a mind that can accommodate a lot of ideas, thoughts, and actions that the amount is more than the conscious mind. The influence of the subconscious mind in the daily life is about 85-90% that can help people in increasing values, confidence and trust. While the critical factor is the restraint of the conscious mind and the subconscious mind, which acts as a filter of all the information that will be brought into the subconscious. When in a conscious state, the critical factor becomes an obstruction of the incoming information into the subconscious mind. Therefore, with hypnoteaching method teachers help students to undercut critical factor.

Hypnoteaching method provides many benefits in the learning process. Hypnoteaching can provide and create a fun learning environment, in which the negative perception of the teacher and the lesson will change. The atmosphere as this will enable the student to absorb and understand the lessons. The following is a benefit of hypnoteaching (Yustisia) [10]: (1) Learning to be more enjoyable, both students, and teachers; (2) Growing the linkage of students in learning with a variety of creative games that applied by teacher; (3) The teacher becomes more proficient in managing emotions; (4) Fostering a harmonious relationship between teachers and students; (5) Teachers can help students who have difficulties in learning through a personalized approach; (6) Teachers can motivate students through the hypnoteaching game; and (7) The teachers help the students in eliminating bad habits of students.

According to Noer (Yustisia) [10] stages conducted in hypnoteaching are:

1) Self intention and motivation

The successfulness of a person basically is depending on their intention to achieve it. From that intention then motivation of the teacher to applied the hypnoteaching method in class is developed, thus expected to help the students to understand the materials given.

2) Pacing

Pacing are meant to adjust the position, body movement, language, and brainwave in equal manner to the students. Naturally and instinctively, every people should be comfortable and had pleasure to gathering with other people who had something in common. From this comfortable feeling, messages from the teacher are expected to be more easily to be received by the students. The teacher, in this condition are could be: thinking to be as a figure with similar age as the students, using language used by the students, perform movement or mimics that related to the theme discussed in the class, and the teacher can also relate the discussed materials to the daily life of the students.

3) Leading

Leading are expected to direct. Leading are done after the pacing, where the students are already comfortable with the class atmosphere. In this condition, the teacher could be direct the student. So, although in actuality the given material is rather difficult, the students' sub-consciousness is more easily to accept.

4) Giving positive words

This is a supporting step in pacing and leading. The use of positive words is suitable with how the sub-consciousness are work which tend to reject negative words. Positive words given by the teacher are believed to be able improving the students' confidence in receiving the materials given. For example, the teacher is expected to avoid the use of "be quiet", and advised to use "your attention please" instead.

5) Compliment

Reward or punishment are not something wrong to be applied in class. Compliment are reward to improve the self-esteem of a person, and punishment is a penalty or warning given by the teacher when students are deemed to have inappropriate behavior. From the reward, students are expected to be motivated to improve their performance. In other case, punishment is expected to made students avoid inappropriate or norm breaking acts

6) Modelling

This steps are a process to give a role model for example from the teacher to the students by consistent words and behavior. Modelling is applied to develop students' trust to the teacher

7) Mastery of the materials

A teacher should be well prepared to the materials presented in the class and relate it contextual condition in order to help student more easily to understand the respective materials.

Based on these review, it could be concluded that hypnoteaching is an educational method that insists on giving suggestion to the student along the learning process, where the teacher using a certain "subconscious language" that expected to develop interest in students that led to improvement of their way of thinking.

C. Self-Belief

Self-belief are often defined as internal factor in a person which affect their attitude in daily life. According to Raymond [11], trust in mathematics are defined as "personal judgments about mathematics formulated from experiences in math". Similar thing is stated by Eleftheories and Theodosios [3] "We will use the term "beliefs" in the meaning of personal judgments and views, which constitute one's subjective knowledge, which does not need formal justification".

Self-belief are included as affective aspect. This aspect important role in mathematics and mathematical education. This was stated by McLeod (Maab and schlogman) [12] that in mathematical education affective aspect are including emotional, behavior, and belief. This aspect is given in order to improve stability and cognitive elements. Kloosterm (Kislenko) [13] stated that belief is a something that are known and perceived by the students as effect of learning math. In another view, belief is related to student's effort to prepare in learning math.

Maab and Schlogman [12] stated that self-belief of the student became interesting issue to explored, because self-belief has tightly related to math or math education. Self-belief has positive effect to the improvement of students' achievement. This is in line with the Maab and Schlogman's opinion that in math education, self-belief became an important predictor in teaching. Beside, self-belief also very important as foundation of the student in math studies.

The research of Perkins, Adams, Finkelatein, and Wieman [2] concluded that there is positive correlation between the self-belief of the student with conceptual learning and stated that self-belief was a factor that affect the learning of the student, which have resulted in successfulness in study and remarkable achievements. Along with it, research of Eleftheories and Theodosios [3] showed that there is also positive correlation between strong confidence with good capabilities and performance in math.

Based on the review of several opinion and two research result, it can be concluded that self-belief of the student to math is a factor that can lead the students to their best achievement, especially in math and math studies. Therefore, this aspect needs critical attention from the teacher, so that math wouldn't become fearsome for the students. Teacher should become a facilitator in improvement of the student's confidence in learning math, so implicated to the improvement of students' achievement.

D. Hypnoteaching Method in developing Self Belief Student

Math is one of the subject which is full of concept. Concept is defined as abstract idea which became differing characteristic between one object with another. As with the standpoint of Howard (Schunk) [14] which stated that a concept is a real arrangement ore categorical representation which allow people to recognize examples and that which isn't categorical examples. That concepts are could cover concrete objects or abstract ideas. Therefore, abstract idea causing math concept are relatively difficult to be understand and applied in solving problems in daily life. Thus, this became the duty of the teachers in creation of learning that relate math with concrete matters of students' daily life.

Beside creating a concrete learning, teachers also able to use hypnoteaching method to sustain the learning process. Hypnoteaching method is having some advantages, which is : (1) Learning process is became more dynamic and creating conducive interaction between student and teacher; (2) Student are studying based on their interest and talent; (3) Many skills given in hypnoteaching; (4) Variety of earning process; (5) Mastery of the materials by the students are faster and easier; (6) Very active learning process; (7) Students in learning can be intensively observed; (8) The ability of student to imagining and thinking are more noticeable; (9) Students studying in good mood; (10) Students are having high understanding and absorptivity on the lesson and could be memorized in a long time; (11) Student are more focused in the study.

Math learning that adjusted with cognitive level of the students and supported with hypnoteaching learning model which emphasized on giving suggestion to the student. Student could be asked to focus in learning and understand the lesson given. Teacher also could convey positive words to motivated the students in learning. These words could be received by the student's sub-consciousness. Thus, hypnoteaching method could help student to develop self-belief which then giving positive effect to the student's achievement in learning. Self-belief are often defined as internal factor in a person which affect their attitude in daily life. According to Raymond, trust in mathematics are defined as "personal judgments about mathematics formulated from experiences in math". Similar thing is stated by Eleftheories & Theodosios (2007) "We will use the term "beliefs" in the meaning of personal judgments and views, which constitute one's subjective knowledge, which does not need formal justification".

III. CONCLUTION

As the importance of students' Self-Belief in improving learning achievement of mathematics and mathematical characteristics of primary school in concrete learning-oriented, then the use of hypnoteaching method with all its advantages have strong relevance to be applied in teaching mathematics. This is because the method has great potential in ensuring students on their success in learning mathematics.

Hypnoteaching method focuses on verbal communication filled with positive suggestions, so that students feel comfortable and high concentrated in the learning process. The atmosphere as this will enable students to absorb and understand the lessons. In addition, this method also implied to an increased interest, motivation, confidence and mathematics learning achievement of students. Strong confidence makes the negative perception of students towards teacher and mathematics will change. Mathematics subjects will be eagerly awaited by the students every day, for teacher and learning materials taught are very interesting, fun and easy to understand.

However, success in improving students' confidence depends on the ability of teacher applying methods hypnoteaching. In the process of implementing this method the teacher required: (1) Having the intention and motivation inside; (2) Pacing; (3) leading; (4) providing positive words; (5) Giving praise; (6) Modeling and (7) mastering the material. The reliability of teacher in implementing all of the syntaxes of this method becomes the deciding factor in the successful use of hypnoteaching method, which is expected to realize the goal of learning and growing students' self-belief in mathematics.

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ME – 22

Analyze of The Creative Thinking Level of Students Junior High School Viewed From Mathematics Anxiety

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***Abstract*—**This research was a qualitative descriptive research. Creativity is an important aspect to face the global challenges. Creativity is the product of creative thinking. By means of creative thinking, people can create something new and different, and people also can solve the problem with the various of problem solving. Creative thinking is not a talent. It is a skill that can be learnt. It improves people by adding strength to their natural abilities which improves teamwork, productivity and where appropriate profits. Creative thinking is needed for students to develop their thinking system and it is important for supporting them to solve the problem in the real life. Every students has different levels of creative thinking, specifically for mathematics creative thinking. The aim of this research was to analyze the level of creative thinking of junior high school students beside on mathematics anxiety's students. The subjects of this research were taken by using purposive sampling. The subjects of this research were six persons from 9th grade student of SMP N 3 Colomadu Karanganyar regency. The data were collected by questionnaire and task-based interview technique and validated by using time triangulation. Analyze of the data used data reduction, presentation, and conclusion. The result of this research showed: (1) students with high mathematics anxiety had creative thinking level 1 (almost not creative), (2) students with medium mathematics anxiety had creative thinking level 1 (almost not creative) and creative thinking level 2 (quite creative), (3) students with low mathematics anxiety had creative thinking level 2 (quite creative).

Keywords:*creative thinking level, mathematics anxiety.*

I. INTRODUCTION

One of the main purposes in mathematics learning is developing creative thinking skills. Creative thinking skill is an ability to face mathematics problem in order to get its solution. Creative thinking skill is not only to get the solution of the mathematics problems but also for the problem at their real life. Therefore, creative thinking skill has to be developed in mathematics learning. In spite of creative thinking skill is important in mathematics learning, the fact is creative thinking skill have not been given any attention [1]. Sisk in [2] described that mathematics learning was studied commonly by introduce the formula in mathematics and the concept verbally for the students. There is no attention about student's understanding the formula and concept. Developing the logical reasoning, creative and problem solving thinking skills have not noticed yet in mathematics learning. This condition can lead the students off the development of imagination and creativity optimally. It caused the students do not trained for doing intuition, imagining, and trying to solve the problem with various solution.

The research of [3] shows that there are positive influence between creativity and achievement of 11st grade senior high school student. it means if student's creativity was increased, then student's achievement will be increased. In addition, the research of [4] shows the equivalent result, there were positive and signification influence between creativity and achievement of 9th grade junior high school student. Based on two research mentioned, it can be concluded that student's creativity influences student's achievement. If student's achievement is low, then one of the influential elements is student's creativity and it is said that student's creativity is low.

The Percentage from the result of UN 2014/2015 at Karanganyar shows that the test result of plane area material is 56,46%, it is lower than the result of the others material, that is 89,77%. It shows that the student's achievement on plane area material is low, so it means that the student's creativity is low as well. The first survey that have been done by giving mathematics problem solving-task about plane area material and the result, there is different level about student's level of creative thinking, that is level 1 and level 2.

The research from [5] shows that there was various level of student's creative thinking in mathematics problem solving viewed from gender and motivation. As pointed in [5], motivation is an internal condition which can determine behavior and it influences student's problem solving. So, the internal element influences student's level of thinking skill. However, does it influence to the student's level of creative thinking skill. Mathematics anxiety is student's internal factor influences student in problem that problem-solving activity, then it would be researched about various level of creative thinking viewed from mathematics anxiety.

There are many students feel hard to get solution when solving the mathematics problem. Sometime, they also feel not good enough at mathematics learning. That condition can head off the students reach the aim of learning in mathematics learning. One of the problems is mathematics anxiety which felt by students. The anxiety appear as the result from student's experience in mathematics learning. The condition where students feel worried and strained were called as mathematics anxiety.

Mathematics anxiety is a condition that headed off the students to reach learning experience and mathematics assessment [6]. Reference [7] defines the mathematics anxiety as worried and strained feeling and it annoyed the people when facing mathematics not only numeral manipulation but also mathematics problem solving in mathematics learning and the real life. Reference [8] describes the indicator of the students who have mathematic anxiety, that are (a) the students was difficult for doing mathematics, (b) the students avoided mathematics class, (c) the student felt sick, dizzy, afraid, and panic, (d) the student didn't solve the mathematics task. Reference [8] classified four level of mathematics anxiety that were high mathematics anxiety, medium mathematics anxiety, low mathematics anxiety, and no mathematics anxiety. This research used three kind level of mathematics anxiety, that were high level, medium level, and low level of mathematics anxiety

Mathematics anxiety which felt by student would influence their psychic and emotional. Reference [9] describes about mood and emotional were center of thinking process. So, the mathematics anxiety would disturb process of thinking, specifically creative thinking process in mathematics learning and mathematics problem solving. Agree with that, [10] at his research showed that positive emotional determined the better result at three dimension of creativity that was fluency, flexibility, and novelty. It means, the negative emotion caused the negative impact for creativity. The result of Foong as in [11] research concluded that not only mathematics anxiety but also mathematics task anxiety had negative correlation with student's mathematics achievement. Specifically about creativity, Haylock as in [12] describes that the high creativity of mathematics would make student have low level of mathematics anxiety.

Reference [13] has researched about level of student's creative thinking in mathematics problem solving and problem posing. The result was gotten the level of student creative thinking and characteristic of creative thinking stage that is synthesis the idea, building the idea, planning to apply the idea, and applying the different idea on every level of creative thinking. The result of mathematics creative thinking level were level 4 (very creative), level 3(creative), level 2 (quite creative), level 1(almost not creative), and level 0 (not creative).

Edward as in [7] defines that Creative thinking is not a talent, it is a skill that can be learnt. It improves people by adding strength to their natural abilities which improves team work, productivity and where appropriate profits. So, the creativity can be developed based on personality skill. Reference [14] defines that creative was an element of synthetic skill (divergent thinking), analyzed skill (critic and convergent thinking), and practice skill. Reference [15] defines about creativity of mathematics as a thinking abilities divergently and production the number of idea originally.

Level of creative thinking was stage of thinking hierarchical based on the product of mathematics creative thinking that was viewed from aspect of creativity. The aspect of creativity was fluency, flexibility, and novelty. The fluency is indicated when the student fluently produces different ideas which were appropriate to the question task. The flexibility refers production of some ideas which were used to solve a task. The novelty is the main characteristic to assess the product of creative thinking. The three aspect of creativity not only determined on mathematics problem solving, but also on mathematics problem posing. This research used modify of the level of creative thinking which developed by reference [13]. The levels are (1) level 4 (very creative), the subject fulfill the fluency, flexibility, and novelty aspect; level 3(creative), the subject fulfill the fluency and novelty aspect; level 2 (quite creative), the subject fulfill the fluency and flexibility aspect; level 1(almost not creative) the subject fulfill the fluency aspect, and level 0 (not creative), the subject doesn't fulfill any aspect of mathematics creative thinking.

Based on that description, there are relationship between level of creativity and level of mathematics anxiety. The level of creative thinking is the level of creativity for doing and getting solution in mathematics problem solving. The level of mathematics anxiety shows the level of student's anxiety when facing the mathematics learning and mathematics problem solving. In this research, the level of creative thinking use five classification as modify from reference [13] and the aspects of creative thinking are fluency, flexibility, and novelty. In this research, the indicator and level of mathematics anxiety use three classification, that are high level, moderate level and low level of mathematics anxiety. So, the aim of this research is to analyze how do the level of creative thinking on mathematics problem solving viewed from mathematics anxiety.

II. METHOD

The research approach was qualitative research which aim to identify the level of student's creative thinking viewed from student's mathematics anxiety. The method for determining a sample subject used purposive sampling. The subjects of this research were six persons from 9th grade student of SMP N 3 Colomadu Karanganyar regency. At the first time, students were given questionnair of mathematics anxiety. From the result of this questionnair, students were classified based on the level of mathematics anxiety. The level of mathematics anxiety are high mathematics anxiety, moderate mathematics anxiety, low mathematics anxiety, and no mathematics anxiety. Subjects of this research were selected from high level, medium level, and low level of mathematics anxiety. Finally, the subjects were six students and they are two students have high mathematics anxiety, two students have medium mathematics anxiety, and two students have low mathematics anxiety.

The data were collected through questionnaire and the task-based interview to the 9th grade students on junior secondary school. The main instrument at this research was the researcher. The secondary instrument at this research were (1) the questionnair of mathematics anxiety, (2) the task of problem solving, and (3) the guide of interview. The questionnaire of mathematics anxiety was used to get information about student's mathematics anxiety and the result was used to determine the subjects of this research. The problem solving task was used to identify the level of creative thinking students. The task was an open-ended task.

Triangulation was conducted by giving another equivalent task for students and interviewing them again deeply. The student's work was analyzed by identifying the correctness of the answer, then checking for aspects of creative thinking (fluency, flexibility, and novelty) in problem solving. Analyze of the data used data reduction, presentation, and conclusion.

III. RESULT AND DISCUSSION

A. Result

The results of this research were (1) the student, who had high mathematic anxiety, got level 1 (almost not creative) of creative thinking, (2) the students, who had moderate mathematic anxiety, got level 1 (almost not creative) and level 2 (quite creative) of creative thinking, and (3) the student, who had high mathematic anxiety, got level 2 (quite creative) of creative thinking.

B. Discussion

The result of this research described the level of creative thinking students based on their level of mathematics anxiety. The subject who had high mathematic anxiety could solve the problem correctly and they solved the problem by the proper algorithm. They could not give another solution for the problem. They didn't have any interest for solving the problem by other method. So, the subject who has high mathematics anxiety just filled the fluency aspect. Based on the level of creative thinking, the subject that just filled the fluency aspect had the level 1 (almost not creative) of creative thinking.

Two students who have moderate mathematics anxiety had the different result. One of the student could solve the problem correctly and he solved the problem by the proper algorithm. He could not give another solution for the problem. The other student could solve the problem correctly and he could solved the problem with other solution. So, the first student just filled the fluency aspect and the others could fill fluency and flexibility aspect. Based on the level of creative thinking, the subject that just fulfilled the fluency aspect had the level 1 (almost not creative) and the subject that fulfilled the fluency and flexibility aspect have the level 2 (quite creative).

The subjects who had low mathematics anxiety could solve the problem correctly and they could solved the problem with other solution. So, they could fulfill fluency and flexibility aspect. Based on the level of creative thinking, the subject that fulfilled the fluency and flexibility aspect had the level 2 (quite creative) of creative thinking. Based on field note, the subject who had low level of mathematics anxiety did not look stressed when doing mathematics problem. At the first time, subject did not feel confident when asked to do mathematics problem. The subject was afraid if the problem was difficult and he could not solve the problem. But the subject felt more confident than before when he was reading and understanding the problem. It showed that the subject felt anxiety when first facing mathematics problem, because the subject prejudiced that the problem would be so difficult for him. This anxiety was low level of mathematics anxiety. As in [16], the people who had low level of mathematics anxiety would feel unconfident and afraid, sometime there were physical indication, like tremble. Agree with that, [17] described that people who had mathematics anxiety was strained and anxious, but that feeling would come infrequently for the people who had low level of mathematics anxiety. So, the subject who had low level of mathematics anxiety could solve the mathematics problem properly, but when they met the difficult one, they thought to give up with the problem.

The result of this research was supporting the other research which the conclusion of its research was the student who had low level of mathematics anxiety have the better achievement than the student who had high and moderate level of mathematics anxiety. The low level of mathematics anxiety was brought positive influence for student on mathematics problem solving and their mathematics achievement. The subject who had low level of mathematics anxiety well did every stage of creative thinking process on mathematics problem solving at circle material. The subject through every stage of creative thinking process that is preparation, incubation, illumination, and verification. The subject who had low level of mathematics anxiety also fulfilled the fluency and flexibility aspect of creative thinking. By the creative thinking like that, the student's achievement would be better than the subject who had high and moderate level of mathematics anxiety. The result of this research, the subject who had low mathematics anxiety had level 2 (quite creative) of creative thinking and the subject who had high level of mathematics anxiety had level 1 (almost not creative) of creative thinking. It means the level of subject who had low level of mathematics anxiety higher than subject who had high level of mathematics anxiety.

IV. CONCLUSION

The conclusion of this research were: (1) the student who have low level of mathematics anxiety had level 2 of creative thinking (quite creative), (2) the student who have moderate level of mathematics anxiety had level 2 of creative thinking (quite cre ative) and level 1 of creative thinking (almost not creative), (3) the student who have high level of mathematics anxiety had level 1 of creative thinking (almost not creative).

The suggestion based on this research were: (1) teacher can give open ended and challenge problem, and ask the student to solve the problem with various solution, so the student will be trained to increase their creativity on mathematics problem solving; (2) teacher should give motivation for student, especially student who have high level of mathematics anxiety, because the student feels afraid for facing the mathematics and hard mathematics problem, and the teacher can contiguous the student who have moderate and low level of mathematics anxiety and give the problem as high as their skill; (3) the student who have mathematics anxiety should do cleverly the mathematics problem which easier, then the student will habitual about mathematics problem and the student can understand in mathematics learning step by step; (4) the result of this research can be reference for another researcher for developing the model of learning which increasing student's creativity and decreasing student's mathematics anxiety.

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ME – 23

The Technique and Validation of Composing the Attitude Assessment Instrument for Junior High School Mathematics Learning Based on Curriculum 2013

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***Abstract*—**Assessment is one of the important components that have to be attention in order to support the success of Junior High School Mathematics learning implementation based on Curriculum 2013. The accountable assessment results will be obtained if the assessment instrument uses a good quality that is proved by having a good content validity and align with Curriculum 2013. Therefore, assessment of Junior High School Mathematics learning based on Curriculum 2013 should use appropriate instrument arranged through the appropriate steps in order to generate a good quality and accountable assessment instrument..Through some theories, this paper studies the technique of composing the attitude assessment instrument for Junior High School Mathematics learning that can generate the instrument of attitude assessment based on Curriculum 2013. The technique of composing instrument in this paper contains of steps to compose the assessment instrument that can generate attitude assessment instrument theoretically. It shows that attitude assessment instrument has a good content validity and it is align with Curriculum 2013. In addition, this paper also discusses the studies about how to validate the instrument in order to get a good content validity and align with Curriculum 2013.

Keywords: *assessment, attitude, instrument, mathematics, validation*

I. INTRODUCTION

Through the curriculum in 2013, the government tries to develop Graduate Competency Standards increasing from the previous curriculum and balancing between soft skills and hard skills. It changes one important elements in Curriculum 2013. The changing is the standard educational assessment. Based on Permendikbud No. 53 of 2015, it states that the scope of the assessment of learning outcomes by educators in primary and secondary education includes aspects of attitudes, aspects of knowledge and skills aspects. The assessment objectives of learning outcomes by educators in primary and secondary education by Permendikbud No. 53 of 2015 are: (a) determine the level of mastery of competencies; (b) establish mastery of competency; (c) establish a program for remediation or enrichment based on the level of mastery of competencies; and (d) improve the learning process. It means that the assessment based on Curriculum 2013 need qualified assessment instrument that can measure the achievement of students competency well and able to fulfill the accuracy and accountability of the assessment results.

Based on the reflection results of the implementation Curriculum 2013 which is done by the coach directorate of Junior High School in 2014 show that based on the quantitative report approximately 34% teachers who had been trained were less understanding of assessment based Curriculum 2013. Relate to the assessment process shows that about 22% teachers have difficulty in assessing the attitude aspect and 14% teachers have difficulty in assessing the skill aspect. Based on the qualitative report shows that the trainer's understanding toward assessment aspect based on Curriculum 2013 was still lack. The teachers expect special training or assistance related to the particular assessment [1]. In addition, more than 50% teacher respondents state that they have not been able to design, implement, and process the results of an assessment well. The main difficulty faced, such as formulate indicators, formulate points of the instrument, and implement, the assessment attitude by various techniques [2].

From the results of reviews these reflections, through the revision of the Curriculum 2013 which will be implemented in the beginning of the academic year 2016/2017, the government simplifies the assessment activity that should be done by teachers. Assessment activity is made simpler, affordable to do, not overlap, not a burden for teachers/students, but still maintaining the principles and rules of assessment. The simplification is the assessment for attitude aspects (social and spiritual) done by PPKn teachers and religious education teachers, while other teachers who teach other subjects only assess the academic aspects of the field that is taught. Teacher of other subjects, such as math, assesses attitude aspect but it just to add a reference or input in assessing the students' attitude. In addition, the assessment activities carried out do not only assessment of learning, but also assessment for learning and assessment as learning.

One of the criteria that should be considered related to the quality of the attitude assessment instrument is validity. During this time, the validity verification of an attitude assessment instruments are generally seen by content validity and construct validity. Especially for content validity evidence is generally done by rational analysis through expert judgment and evidence of construct validity with factor analysis. Development in the theory of measurement shows that the content validity of an assessment instrument can also be obtained through the study of alignment between the assessment and standards in the curriculum. This is as Ananda which states that alignment can be source for evidence of content validity, construct, and consequential [3].

Based on the statements above, it shows that student learning outcomes based curriculum 2013 measured on aspects of attitudes, knowledge, and skills. But until now, the teachers including math teachers still have difficulty in arranging an assessment instrument in particular on attitude aspect. Therefore, the composing guideline of attitude assessment instrument is urgently needed by teachers in composing the instrument that will be used in conducting the assessment. Besides, the paper will also discuss how to prove the validity of its contents. The composing technique of attitude assessment instruments is the steps of composing the attitude assessment instruments that can generate qualified attitude assessment instruments and align with Curriculum 2013.

II. ATTITUDE ASSESSMENT IN MATHEMATICS LEARNING OF JUNIOR HIGH SCHOOL BASED CURRICULUM 2013

Understanding of attitudes have been suggested by experts as Baron & Byrne that gives a definition of the attitude that someone provisions in evaluating either positively or negatively towards others, oneself, thing, or matter [4]. Attitude has constant characteristic all the time so momentary feeling is not counted as an attitude. This is similar to Ajzen who argues the definition of attitude as the disposition of the individual to respond positively or negatively to an object, person, institution, or event [5**]**. Based on some opinions above, it can be concluded that the attitude is a state in human beings who motivate to act or behave in a permanent or momentary feeling either positive or negative to the situation or conditions in the surrounding environment.

It is not different from the various definitions about the attitude, based on the Curriculum 2013, the attitude is defined as an expression of values or philosophy of life that is owned by someone and manifested in behavior. Attitude assessment in mathematics is an activity to identify trends spiritual and social behavior of students in daily life inside and outside the classroom as a result of education [2]. Based on Curriculum 2013 competencies characteristic of attitude dimension refers to the affective domain taxonomy Krathwohl [6]. Based on guideline of learning outcomes assessment by educators in 2015, it is mentioned that the attitude assessment is made by the subject teacher (during the learning process in school hours) naturally, counseling teachers, and homeroom (during the students outside class hours) which is written in the journal. Besides, self-assessment and peer-assessment can be done in the framework of development and character formation of students which the results can be used as one of the confirmation data of the overall attitudes. The attitude assessment scheme is presented in Figure 1 below.

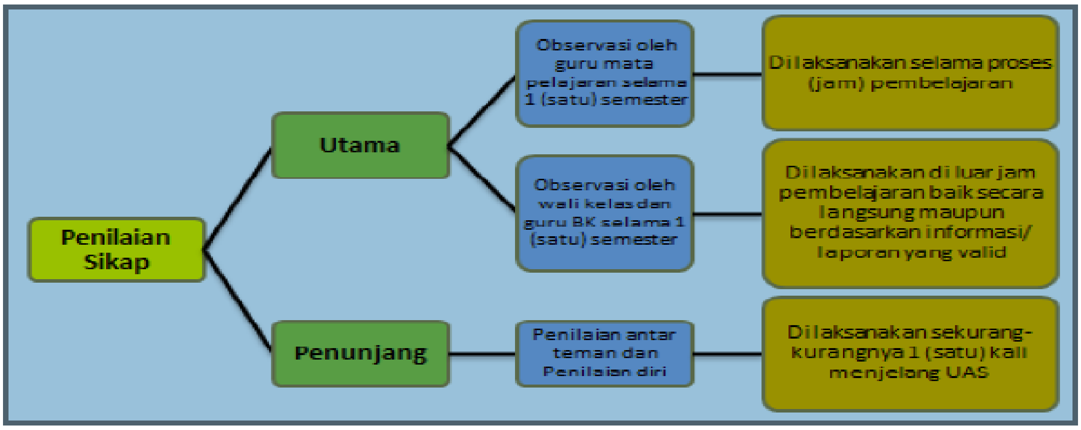

Figure 1.The Attitude Assessment Scheme [2]

III. TECHNIQUE OF COMPOSING ATTITUDE ASSESSMENT INSTRUMENT

An assessment instrument is a prominent key of the successful implementation of educational assessment activities. The quality of the assessment results depends on the quality of assessment instruments used. Therefore, assessment instruments should be composed and developed through the steps that can be accounted so the result of the assessment that is obtained is accurate and reliable. If the assessment instrument is badly designed, the assessment which is done will waste of time and cost. Conversely, if the assessment instrument is designed well, the results can support the quality of information obtained from the assessment results even be one of the factors that can improve the learning outcomes of students.

Nitko state five basic principles in assessment, such as: (1) determine clearly what will be assessed; (2) Ensure that the assessment technique selected suitable for assessing what will be assessed; (3) Ensure that the assessment techniques are selected according to the students' needs; (4) If possible, make sure the use of various indicators of learning outcomes for each assessment targets; and (5) Ensure that when interpreting the results of the assessment, had been obtained enough information about the students [7]. Development of instruments according to Wilson, such as: (1) map constructs, (2) items, (3) scores items, and (4) measurement. In general, based on the Queensland Studies Authority procedure development of assessment instruments that can be done by teachers includes steps as follows. (1) Start with a general purpose syllabus: determining the general objectives aspect which can be assessed; (2) refers to the standard matrix for relevant descriptions to the selected general purpose; (3) develop instruments that enable learners to show attributes assessed; and (4) develop criteria on instruments sheet based on the selected attributes of a standard matrix. Related to the attitude assessment, Djemari Mardapi suggests steps of the development of affective assessment instruments as follows: (1) determine the specifications of instruments, (2) writing instruments, (3) determine the scale of the instrument, (4) determine the system of scoring, (5) examine the instruments, (6) test, (7) analyze the instruments, (8) assemble instruments, (9) carry out measurements, and (10) interpret measurement results [8].

Attitude assessment based Curriculum 2013 refers to the affective domain taxonomy of Krathwohl the which includes five stages, such as receiving, responding, valuing, organization, and characterization by value as follows: (1) Receiving, it describes the stages awareness or sensitivity to the presence of certain ideas, material, or phenomena and are willing to tolerate the willingness to recognize the existence of a phenomenon in its environment. This stage is the opener one's senses to the world; (2) Responding, it is the second taxonomic phase as form of reaction to the phenomena that exist in the environment. At this stage learners do not only pay attention to the phenomenon but also give react. A high level at this stage is interest; (3) Valuing, it is relating to award or assessment given on an object, phenomenon, or behavior. Degree range is from receiving a value to the level of commitment. Assess stage or appreciate do not only accept but also assess the value of a concept or good or bad phenomenon; (4) Organization, it is fourth phase that combines different values, solves conflicts, and establish a consistent value system. Organizing occurs when a person is in a situation where there is more than one value; and (5) characterization by a value or value complex, it is the highest stage which means to act in a manner consistent with the values of individuals who have been internalized. At this stage, learners have a value system that controls behavior until a certain time to form a lifestyle or one-self [9].

Based on the reasons the above, it can be arranged a composing technique of assessment instrument for mathematics which refers to affective taxonomy by Krathwohl with the following steps:
(1) Determine the purpose of the attitude assessment which will be assessed.
This step is done by looking at the basic framework and structure of Curriculum 2013 for junior high school mathematics especially Basic Competency on the material that will be assessed.
Example:
The following Basic Competence in statistical material based Curriculum 2013 class VII.
Basic Competencies:
2.3. Behave honestly and responsibly as a implementation form of honesty in reporting observational data.
Based on the basic competencies, it can be determined the purposes of assessment that will be done by assessing the attainment of students' attitude on the matter of statistics and opportunities. The attitude assessed are being honest and responsible attitude.
(2) Develop the lattice of attitude assessment instruments.
Composing the lattice of assessment instrument is done by determining the conceptual definition of values of attitude which will be assessed. Conceptual definition is formulated based on the results of theoretical studies of various reference or expert opinion. Referring to the conceptual definition, it is formulated operational which is explained into operational indicators and each indicator also refers to the charge Krathwohl taxonomy. The content of affective aspect according to taxonomy Krathwohl include: receiving, responding, valuing, organization, and characterization by a value or value complex.
(3) Choose the assessment techniques and determine the type of measurement scale.
Based Curriculum 2013, the attitude assessment techniques that can be used is observation, self-assessment and peer assessment. After selecting assessment techniques, it is determined the type of measurement scale for example using the subject scale or a response scale in the form of Thurstone scale, Likert scale, Beda Semantics scale, or any other scale.
Example:
Assessment techniques used to measure students' integrity is honest self-assessment in the form of honest attitude scale, in the form of subject scale with three possible answers.
(4) Write instruments items and determine the scoring system and method of interpretation.
Writing items of attitude assessment instruments refers to the scale of measurement that has been determined and indicators contained in the lattice instruments. Scoring system and interpretation method also depends on the measurement scale used.
Example:
The system of scoring for honest attitude scale forms scaling subject with three possible answers are: Answers option which indicate the most honest attitude (Score: 2); Answer option which indicates that answer is less honest attitude (Score: 1); Answer option that does not indicate an honest attitude (Score: 0). The method of interpretation can be made by referring to the following categorization of honest attitude.

Table 1. Categorization of Honest Attitude

Scores of Students	Category Attitudes Honest
$X \geq \bar{x} + 1,5\ s_x$	Very high
$\bar{x} \leq X < \bar{x} + 1,5\ s_x$	High
$\bar{x} - 1,5\ s_x \leq X < \bar{x}$	Less
$X \leq \bar{x} - 1,5\ s_x$	Low

IV. THE CONTENTS VALIDITY OF ATTITUDE ISNTRUMENT

Validity verification of the attitude assessment instruments generally emphasize to content validity and construct validity. The content validity is aimed to know the contents of a measuring instrument if it is representative or not. According Sireci & Bond state that evidence of the content validity of an instrument can be done by traditional and modern approaches [10]. Traditionally, an estimate of the content validity of an instrument is obtained by examining the items instruments reflects and does not reflect the content domain. The most common method to vivificate the validity based content is through expert judgment that look items in terms of: (a) examine the objectives that are tested, (b) assess the item representing content meant, and (c) assess the items which are relevant to the domains tested. Lawshe suggests Content Validity Ratio (CVR) to measure the degree of expert agreement of the items [11]. The level of the contents validity expressed in a single indicator that amount ranging from -1 to 1. Lawshe proposes that each appraiser consisting of the judging panel answer the question for each item with three possible answers: (1) essential, (2) useful but not essential, (3) not required. The formula for calculating the CVR is as follows.

$$CVR = \frac{ne-(\frac{N}{2})}{\frac{N}{2}} \tag{1}$$

where:
ne: The number of experts who give essential response to an item; N: Number of experts.

CVR calculation is made on each item. According to Lawshe, generally, if more than half of panelists show that the item is important/essential, reviews those items have at least the validity of the content. Specifically, CVR score of each item can also be compared with a minimum score of CVR with acceptance of 0,05 as researched by Lawshe.

Another approach related content validity coefficients suggested by Aiken [12]. Aiken V Formula for calculating the content validity coefficient based on the assessment results from the expert panel of n people toward an item in terms of these items represents the measured construct. Aiken V coefficient value ranges between 0 - 1. The coefficient is higher than 0,5 can be considered to have adequate content validity. The formula for V Aiken is as follows.

$$V = \frac{S}{[nx\ (c-1)]} \tag{2}$$

$$S = \Sigma \text{ ni (r-lo)}$$

where:
V: the validity index of Aiken; ni: Number of experts choosing the criteria i; r: Criteria to i.
lo: lowest rate; n: The number of all the experts; c: Number rating/criteria.

As a modern, Sireci & Bond argue that new approaches developing related to the verification content validity is through the test alignment [13]. Alignment between assessment and standards can be defined as the level of agreement that measures the consistency between the standards or curriculum content for a particular subject with the assessment to measure student learning outcomes [13]. This shows that the purpose of the test is to establish the suitability between assessing suitability and content of subjects as contained in the basic competence in the subject. Ndiovu & Mji state Alignment index calculation can be done by using alignment index formula of Porter. Alignment index ranges from 0 (no alignment) to 1 (perfect alignment). The formula alignment of Porter index is as follows [14].

$$P = 1 - \frac{\sum_{k=1}^{K} \sum_{j}^{J} \left| a_{jk} - b_{jk} \right|}{2} \tag{3}$$

where:
a: The number of lines, K: the number of columns in each matrix X and Y,
x_{jk} and y_{jk}: the ratio of cells in row j and k columns for each matrix ratio of x and y.

In general, the index of alignment Porter (P) can be determined in four steps as follows: (1) make a matrix of frequencies for the two documents which are compared, for example, give label as a matrix X and Matrix Y, (2) for each cell in the matrix X and Y, the ratio is calculated by comparing the number of cells in a cell with amount of numbers in each matrix. Label this as aratio matrix x and y, (3) For every row j and column k in the ratio matrix, calculated the absolute value of the difference between the ratio in cells x_{jk} and y_{jk}, and (4) Calculated alignment index.

V. CONCLUSIONS

Composing the attitude assessment instruments in mathematics based on the Curriculum 2013 can be done by steps as follows: (1) Determine the attitude assessment objectives which will be assessed; (2) Develop lattice of attitude assessment instruments for each indicator refers to the operational definition of attitude assessed and affective taxonomy of Krathwohl; (3) Choose the assessment techniques and determine the type of measurement scale; and (4) Write instruments items and determine the scoring system and the method of interpretation. The validity verification of the content on the attitude assessment instrument can be done traditionally by using CVR index and index of Aiken and in modern way by using index alignment.

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ME – 24

The Role of Metacognitive in Problem Solving: A Case in Logarithm

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***Abstract*—**Problem solving ability is the most important goals of learning mathematics. It needs the ability to understand the problem, control, and monitor cognitive processes. Metacognitive skills are a very important element to assist individuals in identifying and formulating a framework or strategy work. The ability of problem-solving strategy is one of the important factors in solving the problem. Lack to draw up a proper strategy will lead to failure anyway in solving problems. This paper presents the results of tests and interviews with two students in solving of the logarithm. The first subject was a student who successfully solve problems with a high score while the second one was low. The results of this study showed that the student with high performance in mathematics able to plan the solve of problems, able to devise problem-solving strategies, monitor of each step, and evaluate the results. In another word, the student has the ability to use metacognitive skills. Conversely, the student with low mathematics performance indicates a failure in the use of metacognitive skills. The results showed a close connection between the problem solving and metacognitive. That skills will aid students in understanding, strategic planning, monitoring the completion of the steps, and evaluate the results obtained. In other words, metacognitive skills will help students in problem-solving.

Keywords: *metacognitive, problem solving, ratio*

I. INTRODUCTION

Problem-solving ability is the most important goal in mathematics learning. NCTM (*National Council of Teachers of Mathematics*) in the *Principles and Standards for School Mathematics* states: "*a major goal of mathematics is to equip students with the knowledge and tools that enable them to formulate, approach, and solve problems beyond Reviews those that they have studied*" [11]. It means the ability to use their prior knowledge to solve mathematical problems is the essence of mathematics. Problem-solving skills in mathematics is the ability to use prior knowledge or connecting mathematical concepts to solve problems that arise in actual situations or "*real world problems*". It means "*problems*" in problem solving are complex, non-routine, open-ended, and challenging. NCTM [11] states that "*Problem solving means engaging in a task for the which the solution method is not known in advance* .." It means there is no method or the regular way to solve the problem.

To success in solving the problems in mathematics required the ability to understand the problem, control and monitor a cognitive process, or in other words metacognitive skills in problem-solving [2,3,8,10,16], as well as the motivation to solve the problem [10]. Metacognitive skills are also very important components to assist individuals in identifying and formulating a framework or strategy to solve the problems (Davidson and Sternberg in [16]). The ability to design the strategy in problem solving is one of the important factors in solving the problem [3]. Failure to draw up a proper strategy will lead to failure anyway in solving problems. A factor that can hinder problem solving is the *mental set* that frame of mind that involves an existing model to represent a problem, the context of the problem, or procedure for solving a problem. Another term for the mental set is *entrenchment* when problem solver has the mental set that is entrenched, they are fixated on a strategy that usually works well in solving routine problems but that strategy does not work well in solving the non-routine problems [17].

Metacognitive terms in education have been quite widely used in recent times relating to optimizing students' skills in problem solving [6], or students' achievement [5]. The important goals in involves metacognitive in learning activities are to improve the quality of learning, especially in mathematics.

There is no agreement among experts on the definition of metacognitive formally, due to the many different kinds of knowledge and processes included in the metacognitive term [12]. But in general, there is a thread that can be drawn to connect the various opinions.

There are several definitions of metacognitive that developed in the field of cognitive psychology including Flavell and Brown. Flavell (in [9]) defines the metacognitive as: ".. *the ability to understand and monitor one's own thoughts and the Assumptions and implications of one's activities*." In other words metacognitive as the ability to understand and monitor the activity of thinking themselves and assumptions as well as the implications of that person's activities. This opinion emphasizes the metacognitive as the ability to understand and monitor the activity of thinking so that the metacognitive process of each person will be different according to their ability. Meanwhile, Brown (in [9]) defines the metacognitive with: "... *the degree to which learners are engaged in thinking about themselves, the nature of learning tasks, and the social contexts. ... as being comprised of activities for regulating and monitoring human learning*. " This means metacognitive as an awareness of cognitive activity itself, the method used to control the cognitive process themselves and a mastery of how to direct, plan and monitor cognitive activity. Brown's opinion emphasizing metacognitive as awareness of cognitive activity, in this case, the metacognitive relates to how a person aware of his thinking process. That awareness will materialize in the way a person organize and manage the activity of thinking process.

Flavell tends to view the metacognitive as a knowledge aspects about a person's cognitive while Brown tended to view as a process of arranging a person's cognitive. Although Flavell and Brown had a different point of view about metacognitive, but both argued that metacognitive includes two aspects are interrelated and interdependent on one another. Flavell [4] suggests that metacognitive consisting of 1) metacognitive knowledge, and 2) metacognitive experience or regulation. On the other hand, Brown also divides metacognitive into 1) knowledge about cognition, and 2) regulation of cognition [7]. Metacognitive knowledge is described as knowledge or belief about the factors, variables that affect the individual's cognitive processes [4]. Brown (in [15]) distinguishes three types of metacognitive knowledge namely declarative, procedural, and conditional knowledge. Declarative knowledge refers to knowledge about themselves as learners and knowledge of the factors affecting performance. Procedural knowledge refers to knowledge of how to use procedural skills to execute. While the conditional knowledge is the knowledge of when and how to use a variety of cognitive activity possessed.

Furthermore, the metacognitive regulation also called metacognitive skills are defined as awareness of cognitive activities themselves, a method for regulating the cognitive process, as well as orders to organize and plan cognitive activity. Jacobs & Paris (in [15]) presents three essential components of metacognitive regulation, namely planning, monitoring, and evaluating. Planning involves choosing the appropriate strategy and effective resource allocation thus affecting the performance. Monitoring refers to the self-awareness to monitor understanding and the task performed. While the evaluating is the process of assessing the solution and the learning process which have been done. On the other hand, Lucangeli and Cornodi (in [2]) states four components of metacognitive skills with a prediction, planning, monitoring, and evaluation. Prediction is the activities to distinguish between the difficult and easy problems to be determined exactly how much effort and resources needed to solve the problems. Planning includes analyzing the problem, take back the specific knowledge and skills already possessed, and to develop problem-solving strategies. Monitoring includes activities to monitor each troubleshooting step is carried out. This is to ensure that the strategy that has been formulated goes well to solve the problems. While the evaluation is to assess the results of the activity and the steps used to get answers. Simon (in [2]) provides the third component of metacognitive called conception or faith, namely metacognitive idea or theory of how people think about themselves and others, such as attribution, motivation, and self-esteem.

Based on the data of tenth-grade students' achievement in the logarithm of SMK Muhammadiyah Delanggu odd semester of 2015/2016 academic year consisting of 24 students, as much as 81% get less value from minimum passing criteria. This indicates the lack of students' performance in mathematics learning, especially on the subject of a logarithm. Most of the students have not been able to complete mathematics problems in a systematic manner. They immediately focus on calculations that are procedural without first understanding the purpose of the given problem. This paper presents the role of metacognitive skills to solve mathematical problems, especially in the matter of logarithms.

II. RESEARCH METHOD

This research is qualitative descriptive. The subjects were two students of tenth-grade students' of SMK Muhammadiyah Delanggu, Central Java, with the category of high and low math skills. The subjects are selected by first giving five essay test questions to all students. The fifth question must be completed within 90 minutes. Furthermore, based on the results of the test, the student's ability to solve problems are classified into three categories, namely high, medium, and low. This study will be the focus on with high and low categories students'. The Data will be collected by using observation, test, and interviews. The observation methods used to obtain data about the math learning activities directly and observe the student in completing the questions given by the researcher. The test method used to obtain data on students' ability to solve problems. Meanwhile, the interview method used to find out information on how the metacognitive skills of students in solving logarithms. The Researchers also provide an assessment of the results of student work related to the logarithm. The acquired data were analyzed by reducing the data, presenting the data, and drawing the conclusion. Data reduction was performed by recording the interview result, and observation of teachers and students. The researcher also scored the students' answer related to logarithmic materials. After the data went through reduction process, the data would be presented in a complete narrative text, tables, and records of interview result regarding the students' understanding of logarithmic materials. The last step was to draw conclusion based on the result of data spread

III. RESULT AND DISCUSSION

Based on the test results of 24 students', there were seven students with high math ability and students lower category. The remaining 10 students, that are in the moderate category. Afterward, the students with high category (subject 1) and low (subject 2) are selected as research subjects. In this paper presented the results of the test and a description of metacognitive skills of high and low categories students' in solving problem 3. Problem number 3 is presented as follows:

Question:
Let *log* 2 = 0.3010 and *log* 3 = 0.4771, determine the value of:

a. *log* 12
b. *log* 24

The answer of subjects 1 and 2 in solving problem 3 is presented in Figure 1 and 2 as follows:

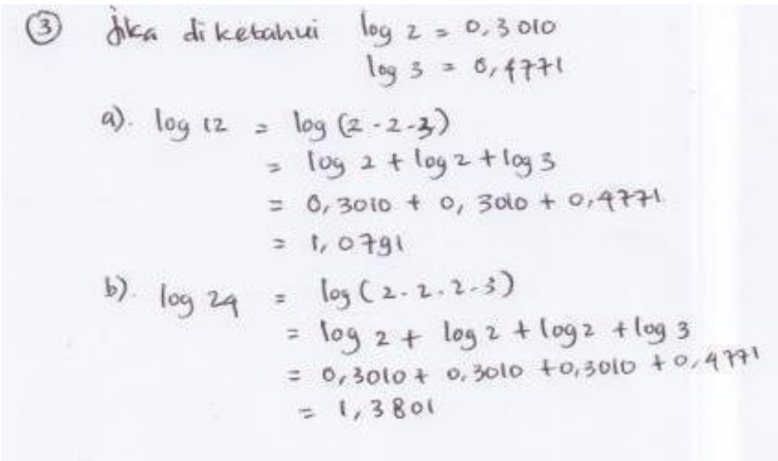

Figure 1. The answer of subject 1

Figure 1 shows the students answer with the high category in solving problem 3. It shows that the students are able to solve problems correctly. Interviews showed that students understand the purpose of the questions that must be resolved namely determining *log* 12 and *log* 24. Students are also able to understand the information given in problem, namely *log* 2 = 0.3010 and *log* 3 = 0.4771. Based on the knowledge that has been owned by the students (prior knowledge), then the students determine the relationship between the known and asked information of the problem. Students said that to determine *to log* 12 first determining the multiplication factors of 12 namely 2, 2, and 3.

Subject 1 : multiplication factors of twelve are 2, 2 and 3. So *log* 12 = *log* (2 x 2 x 3).
Researcher : Why you choose 2 x 2 x 3? Why not 4 x 3?
Subject 1 : Due to the unknown *log* 2 and *log* 3.

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Interviews showed that students were able to determine the relationship between the known information on the matter and the problems in question. Furthermore, students able to connect the data obtained, the *log* 12 = log (2 x 2 x 3), with the knowledge that has been held on the multiplication properties of logarithms.

Subject 1 : Continue finished *log* 12 = *log* 2 + *log* 2 + *log* 3

Researcher : Is it the properties of logarithms?

Subject 1 : yes, there is a property in the logarithm *log* (a x b) = *log* a + log b

Interviews showed that students are able to connect information held previously, namely the properties of logarithms, with the information obtained, the log (2 x 2 x 3). The next step is the completion of procedural involving calculations. Students said that after obtaining the answers to the calculation results, students are reassessing to convince the truth of the estimates obtained. Furthermore, to solve the problem 3.b applies same steps with 3.a.

The metacognitive skills of subject 1 in solving problem 3 looks already well underway. Students have been able to understand the purpose of the problem, the information provided on the issues, and to determine a strategy to solve the problems. This means that the student has the ability to perform well completion planning. Furthermore, students have been also able to connect the knowledge that has been owned by information obtained from the problem. Students are doing step by step systematically in order to know where the mistakes if the answer is incorrect. This indicates that the student has the ability to monitor every step in solving a problem. Monitoring measures are taken to ensure the completion of the procedure is done properly. Metacognitive skills that last aspect is evaluation where students have to recalculate to convince the truth of the answers obtained. These results indicate that students who able to control the metacognitive skills will be able to solve the problems appropriately. In other words, metacognitive has a very important role to solve the problems.

Furthermore, the answer of the students with low math skills to solve problems 3 is presented in Figure 2 below:

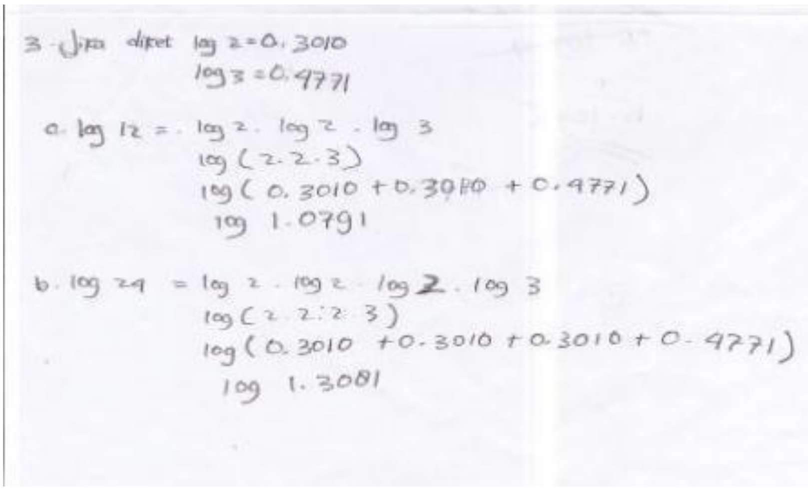

Figure 2. The answer of subject 2

Figure 2 shows that the students answer is not correct. Students can understand the information provided by the problem that is *log* 2 = 0.3010 and *log* 3 = 0.4771. He also understands the purpose of the questions that must be solved namely determining *log* 12 and *log* 24. However, students are not able to determine the exact relationship between the known information with information obtained from the problem. Students understand the multiplication factor of 12 is 2, 2, 3. But the students are not able to connect the concept of multiplying a number by multiplying the logarithms so that students write the *log* 12 = *log* 2 x *log* 2 x *log* 3.

Subject 2 : multiplication factors of 12 is 2, 2, 3

Researcher : How *log* 12 can be *log* 2 x *log* 2 x *log* 3?

Subject 2 : due to the multiplication factors of 12.

The interview results indicate that students are not able to link their prior knowledge with the new knowledge so that they encountered an error. The same thing happened to the completion of a problem 3.b.

Subject 2 is able to understand the information provided by the problem and understand the purpose of the question (asked by the question). But the students failed to design the problem-solving strategy even though he have been able to determine the factors of 12 are 2, 2, and 3. Students are not able to connect the concept of multiplication in decimal numbers with on logarithms. This means that aspects of metacognitive skills in planning the settlement did not go well. Furthermore, a failure in all aspects of planning resulted in less appropriate in solving steps . It appears that students write the *log* (2 x 2 x 3) = *log* (.3010 + .3010 + .4771). The results of these calculations show that students fail to understand the nature of multiplication logarithm.

Researcher : Why *log* (2 x 2 x 3) could be a *log* (.3010 + .3010 + .4771)?
Subject 2 : due to the nature of the logarithm multiplication in that way.
This shows that students do not carry out the monitoring to ascertain whether the steps undertaken are in accordance with the procedure. These results indicate that the failure of students in the use of metacognitive skills will have an impact on the results were not correctly.

The results of this study provide additional information about the importance of metacognitive skills in solving mathematics problems. These results are in line with Bayat and Tarmizi [1] which conducted a study of 86 first-year students who took the algebra courses at universities in Malaysia. The study wanted to test the correlation between metacognitive strategies with the students' ability in solving algebra problems. The results showed that there is a significant impact on the ability of metacognitive strategies algebra students. In other words, students are able to take advantage of metacognitive strategies will be able to solve the problems of algebra well too.

IV. CONCLUSION

Based on the research of two students with high and low math category shows that students who able to plan completion, monitoring every step of completion, and evaluate the results obtained will be able to solve the problems appropriately. In other words, students are able to use metacognitive skills in solving the problems will get the results as expected. Conversely, students who have failed in the use of metacognitive skills would not be able to solve the problems appropriately. Thus, metacognitive skills have a very important role to solve the problems, especially in mathematics.

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ME – 25

Developing Mathematics Instructional Package with POGIL that is Oriented to The Competences in Curriculum 2013

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Abstract**—**The purpose of this research was to produce instructional package in 7th grade on the 2nd semester with POGIL that consisted of lesson plans and student worksheets, which hadgood quality. The quality was determined based on Nieveen criteria, including validity, practicality, and effectiveness. This study was a development research. The developing model in this research was Plomp model, which consisted of preliminary research, development, and assessment phase. The research instruments were validation sheets, teacher assessment sheets, observation sheets for learning process, student assessment questionnaires, tests, questionnaires, and observation sheets for attitudes. The analysis of the validity and practicality of the data was done by converting the quantitative data in the form of assessment result score into the qualitative data in the form of five scale. The analysis of the effectiveness of the test results was conducted by determining the percentage of the students' learning mastery. The assessment of questionnaires and attitudes observation was conducted by determining the percentage of the students for each category. The result of the validation showed that the developed instructional package was very valid based on the lesson plans and student worksheets. The results of the tryout indicated that lesson plans and student worksheets were practical and effective. The instructional packagewas in the very practical category based on teacher's assessment and practical category based on the result of observation for learning process and students' assessment. The instructional package was also in the effective category based on students' learning mastery, questionnaires of religiosity, and questionnaires of attitudes.

Keywords: *competences in Curriculum 2013, development, instructional package, POGIL*

I. INTRODUCTION

The Curriculum 2013 is the newest curriculum in Indonesia which is publised as the recondition of Curriculum 2006. Through Curriculum 2013, the character and competences-based curriculum, Indonesian nationareexpected to become the dignified nation and its people have high competitivenesswith other people and nations in the world [1]. Mathematics learning process in Curriculum 2013 is focused on four competences. Those are religiosity, attitudes, knowledge, and skills.

One of the fundamental things that students can be successful in many areas of higher mathematics is to have automaticity in terms mathematical factual knowledge. Without the ability to retrieve facts directly or automatically, students are likely to experience a high cognitive load as they perform a range of complex tasks [2]. Thus, the factual knowledge becomes the basic knowledge that must be mastered by students in mathematics.

Moreover, several studies have documented that many students are having difficulty in understanding and applying concepts, finding relevance, trasferring skills within and across diciplines, and identifiying and developing the skills they need for success in specific courses [3]. One of the basic mathematical skills that must be possessed by the studentsisproblem solving skills [4].Unfortunately, research shows that students' ability to solve problems is far below their abilities to calculate [5].Mathematics learning process in the classroom do not give opportunities to students for investigating, reasoning, or deciding on the solution process and do not improve problem solving skills [6].

That condition causes a lot of junior high school students have not good achievement in mathematical knowledge and skills. This phenomenon can be seen from many students in 7th grade of SMP N 1 Yogyakarta still getmathematics learning mastery <75 in mid semester test, as shown in Table 1.

TABLE 1. MATHEMATICS LEARNING MASTERY THE 7TH GRADE STUDENTS OF SMP N 1 YOGYAKARTA IN MID SEMESTER TESTACADEMIC YEAR 2014/2015

Class	Percentage of mathematics learning mastery < 75	Percentage of mathematics learning mastery more than ≥ 75
VII A	65%	35%
VII B	37%	63%
VII C	66%	44%
VII D	83%	17%
VII E	77%	23%
VII F	66%	34%
VII G	74%	26%
VII H	32%	68%

Based on Table 1, there are still many students who have not yet achievedmathematics learning mastery≥ 75. It is required animprovement efforts in mathematics learning processto optimize the students' achievement in mathematical knowledge and skills.

Several studiesalso have documented that learning in schools only generates students with a lot of knowledge, yet they are lack of attitudes and skills. Many cases such as corruptions and anarchic actions show that Indonesiasociety isnot consistent with the religous and Pancasila values [7]. The research from [8] and [9] state that religiosity has an important role in the system of education and learning process. Thus, religiosity is an important part of the educational system in a country. Religiosity should not only developed through a religious education subjects, but also require the support of other subjects, including mathematics.

Some attitudes also need to be developed in mathematics learning process. Some attitudes that can be developed in mathematics learning process are confidence, curiosity, and responsibility. The research from [10] concludes that students with high academic achievement show higher level of self confidence than lower academic achiever students. The other research from [11] states that students with greater curiosity in more challenging schools have the greatest academic success. Otherwise, students with greatercuriosity in less challenging schools have the least academic success.

In Curriculum 2013, students should have the four competences in mathematics learning which uses scientific approach with implementation of inquiry learning [12].Unfortunately, many mathematics teachers are not yet able to implement the inquiry-based learning strategies which are appropriate with Curriculum 2013.The strategy which is frequently used by the teachers in mathematics learning process is expository or conventional learning.In addition, the teachers just focus on the students' cognitive domain during the process of learning mathematics.

By interviewingwith mathematics teachersin SMP N 1 Yogyakarta, Mrs. Sri Utami and Mr. Agus Margono on September, 8, 2014 state that the mathematics learning strategy which is frequently used in the class is expository or conventional learning which are focused on the development of students' cognitive domain. Mathematics teachers in SMP N 1 Yogyakarta are not yet able to implement the inquiry-based learning strategies which are appropriate with Curriculum 2013.

One of the learning strategies which are based on inquiry is Process-Oriented Guided Inquiry Learning (POGIL). It can be implemented in mathematics class as an alternative way to develop students' competences in Curriculum 2013. In a POGIL classroom, students work in a teamusing formal roles. The learning team constructs knowledge by working in a group with inquiry activities that has been specially designed in student worksheets [13]. These activities can improve the students' knowledge level by focusing on concept of development. Besides, the students can also apply their knowledge in new contexts. Moreover, the students learn to rely on thinking and performing skills rather than memorizing, and also developing positive relationships with other students [3].

The student worksheets in a POGIL classroom follow the learning cycle model which contains three parts i.e.: exploration, concept invention, and application [13]. Moreover, [13] explains that quiz becomes an important thing in POGIL class. Every period (except the first class period and the period after each hour exam) begins with a three-minute quiz. The purpose of the quiz is to give the teachers some immediate feedbacks about how well the concept is learned by the students, to reinforce the concept in the students' mind and to encourage the students to do the homework before the quiz is given.

Many POGIL classrooms employ formal roles. The roles are frequently rotated in every class meeting, so that every student experiences each role and responsibility. According to [3] and [13], the following are the most commonly used roles: 1) the manager;he/she actively participates, keeps the team focused on the task, distributes work and responsibilities, resolves disputes, and assures that all members participate and understand, 2) the spokesperson (presenter); he/she actively participates and presents reports and discussion result to the class, 3) the recorder; he/she actively participates, keeps a record of the assignment and what the team has done, and prepares a report in consultation with the others, 4) the strategy analyst (reflector); he/she actively participates, identifies strategies and methods for problem solving, observes and comments on group dynamics and behavior with respect of the learning process.

Furthermore, [3]explains that in a POGIL classroom, a teacher is not an expert that solely provides knowledge, but rather as a guide for students in the process of learning, developing skills, and their own understanding. The teacher role in POGIL classroom is as a facilitator who moves around the room observing every student group work. As a facilitator, teacher should observe and determine whether the problem is likely to be solved without intervention [13].

Thechallenge for teachers is to implement the inquiry-based learning strategies inmathematics learning process which are appropriate with Curriculum 2013. Because the implementation of Curriculum 2013 is a new things, the mathematics instructional package which are appropriate with Curriculum 2013 is still very limited. Interviewing with Mrs. Sri Utami and Mr. Agus Margono state that developing mathematics instructional package with POGIL that is oriented to the students' competences in Curriculum 2013 for 7th grade students on the 2nd semester has not been done by the teachers in SMP N 1 Yogyakarta. Therefore, it is necessary an effort to develop mathematics instructional package that enables students to actively construct mathematicalknowledge and skills through group interaction, has religious value and good attitudes.

Based on the background above, the formulation of the problem in this research is how the quality of mathematics instructional package with POGIL that is oriented to the students' competences in Curriculum 2013 for 7th grade students on the 2nd semester? Therefore, this research aims to produce and descibe mathematics instructional package with POGIL that is oriented to the students' competences in Curriculum 2013 for 7th grade students on the 2nd semester, consists of lesson plans and student worksheets which has validity, practicality, and effectiveness criteria [14]. Moreover, the benefits of this research are the teachers can use the mathematics instructional packagefor learning process in a classor in other school, help students to develop religiosity, attitudes, mathematical knowledge and skills, and repair and improve the quality of mathematics learning in school.

II. RESEARCH METHOD

A. *Design of The Research*

This research was development research. The developing model in this research was Plomp model which consisted of preliminary research, development, and assessment phase [15]. The product of this research was mathematics instructional package with POGIL for 7th grade on the 2nd semester which consisted of lesson plans and student worksheets.

B. *Procedure of The Research*

The identification and study aboutstudents'condition, mathematics learning processwhich took place in SMP N 1 Yogyakarta, Curriculum 2013, competences to be achieved by students, and the 7th grade mathematics materials on 2nd semester were conducted in the preliminary research phase. Furthermore, the preparation and design of the lesson plans and student worksheets were conductedin the development phase.The result fom this phase wasthe 1st draft of mathematics instructional package with POGIL. The formative assessment by experts was also conducted in this phase. Itaims to determine whether the 1st draft of mathematics instructional package whichhas been developed valid or not based on expert judgments. Then, tryoutabout mathematics instructional packagewhich has been valid based on expert judgments with the aims to test the practicality and effectiveness was conducted in the assessment phase.

C. Subject Tryout, Time, and Place of The Research

Tryout in this researchwas included the 1st and 2ndtryout. The 1sttryoutwas conducted only limited to a few students on Saturday, February 28, 2015 and aimed to obtain feedback from students as consideration for fixing LKS before it is implemented on learning in the classroom. Subject of the 1sttryoutwas nine students of class VII C SMP N 1 Yogyakarta, consists of three high-ability students, three middle-ability students, and three low-ability students. While the 2nd tryout was conducted on a class by implementing the instructional packagewhich was developed in mathematics learning process to determine the practicality and effectiveness of the instructional package. Subject of the 2nd tryout was students of class VII B SMP N 1 Yogyakarta, consists of 35 students. The implementation of instructional package which was developed in mathematics learning process was done as much as 8 times, 7 meetings for learning and 1 meeting to test and fill the questionnaires. The 1st meeting was began on Tuesday, March 17, 2015 and the 8th meeting was ended on Saturday, April 25, 2015.

D. Instrument, Data Collection andData Analysis Technique

The data in this researchwas data validation expert, teacher assessment, observation for learning process, student assessment, tests, questionnares, and observation for attitudes. The qualitative data was obtained from comments and suggestions on the development of instructional package. The quantitative data was obtained from the filling data collection instrument by giving the check mark (√) in the selection of an appropriate response.

Data collection techniques in this research was done by giving validation sheets, teacher assessment sheets, student assessment questionnaires,tests,questionnaires, and classroom observation through observation sheetsfor attitudesand observation sheets for learning process. Data collection instruments consist of validation sheets to measure the validity of instructional package, teacher assessment sheets, observation sheets for learning process, and student assessment questionnairesto measure the practicality of instructional package, then tests, questionnaires and observation sheetsfor attitudes to measure the effectiveness of instructional package.

Data analysis techniques used in this research: qualitative data in the form of comments and suggestions were analyzed qualitatively, then used as input for revising the products developed; quantitative data with a five-point scale is converted into qualitative data, with reference to the formula which was adapted from [16] in Table 2.

TABLE 2. DATA CONVERSION CRITERIA

Grade	Score Interval	Category
A	$X > \bar{x}_i + 1{,}5SBi$	Very good
B	$\bar{x}_i + 0{,}5SBi < X \le \bar{x}_i + 1{,}5SBi$	Good
C	$\bar{x}_i - 0{,}5SBi < X \le \bar{x}_i + 0{,}5SBi$	Pretty good
D	$\bar{x}_i - 1{,}5SBi < X \le \bar{x}_i - 0{,}5SBi$	Not quite good
E	$X \le \bar{x}_i - 1{,}5SBi$	Not good

Information:

$\bar{x}_i =$ mean ideal score = $\frac{1}{2}$ (ideal maximum score + ideal minimum score)

SBi = ideal standard deviation = $\frac{1}{6}$ (ideal maximum score–ideal minimum score)

X = total actual score

The instructional packagewas said to be valid if the validity which achieved minimum in the category valid. It was said to be practical based on teacher assessment if the practicality which achieved minimum in the practical category, based on the observation for learning process if the percentage of learning process reached at least 80%, and based on student assessment if the practicality which achieved minimum in the practical category. Moreover, it was also said to be effective if the results of the test on knowledge at least 80% of students in the class reached mathematics learning mastery ≥ 75, so did the test on skills.Also the results of questionnaires for religiosity at least 80% of students in the class reached a minimum height categories, and so did the questionnares for attitudes.

III. RESULT AND DISCUSSION

A. *Result of The Research*

The identification and study about the condition of the students wasconducted in the premilinary research phase. The results indicate that there were still many students of class VII SMP N 1 Yogyakarta getmathematics learning mastery < 75 in mid semester test as presented in Table 1. Thus, it was necessary an effortsto improve learning activities so that the achievement of students in mathematics learning mastery could more optimal. Implementation of POGIL in mathematics learning process could be used as an alternative way to provide meaningful learning experiences for students. It was hoped can optimize students' mathematics learning mastery related to knowledge and skills. In addition, students could also develop positive relationships with other students because in POGIL classstudentslearn actively through group interaction. This waspotentialto develop religiosity and attitudes of the students.

The identification and study about mathematics learning process in SMP N 1 Yogyakartawas also conducted in the premilinary research phase. Interviewingwith two mathematics teachersin SMP N 1 Yogyakartastate that the mathematics learning strategy which was frequently used in the class is expository or conventional learning which were focused on the development of students' cognitive domain. Mathematics teachers in SMP N 1 Yogyakarta were not yet able to implement the inquiry-based learning strategies which are appropriate with Curriculum 2013, that was POGIL. Moreover, the mathematics instructional package which were appropriate with Curriculum 2013 wasnot yet developed by the teachers in SMP N 1 Yogyakarta. So, developing mathematics instructional package which consistedof lesson plans and student worksheets with POGIL wasan alternative way for teachers to perform mathematical learning process which were appropriate with Curriculum 2013 easily.

Furhermore, the identification and study about Curriculum 2013 and competences to be achieved by studentswere also conductedin the premilinary research phase. The curriculum used in this research wasCurriculum 2013 which focused on four competences which consistsed of religiosity, attitudes, knowledge, and skills. The four competences that must be mastered by learners are need to be declared in such a way can be assessed as students' learning outcomes. Those become a reference from basic competences and should be developed in mathematics learning process. Then, based on the four competences and basic competencescould be developed indicators to determine the achievement of competences in this research.

The last in the preliminary research phase wasthe identification and study about mathematics materials on 7th grade on 2nd semester. Itwas conducted to identify, specify, and systematically compile the materials developed and tested in this research. The materials were consisted of rectangles and triangles, linear equality and inequalities in one variable and social arithmetic, transformation, and probability and statistics.

The next phase was development phase. In this phase, lesson plans and student worksheets weredesigned.Then, the experts conducted formative assessment to determine whether the 1st draft of mathematics instructional packagewhich have been developed valid or not. Lesson plans weredesigned and developed based on POGIL steps. Besides, the student worksheetswerealso designed and developed appropriate with characteristics of POGIL.

Lesson plans were developed based on Permendikbud Nomor 65 Tahun 2013 about standard process which explained the components that must be presented in the lesson plans. Those were school's identity, subjects' identity, grade/semester, subject matter, allocation of time, learning purpose, basic competences and indicator achievement of competences, learning materials, teaching methods, instructional media, learning resources, learning steps, and assessment of learning outcomes.Four lesson planswere prepared in the first draft. Lesson plans 1 were designed about rectangles and triangles for 10 meetings. Lesson plans 2 were designed about linear equality and inequalitiesin one variable and social arithmetic for 7 meetings. Lesson plans 3 were designed about transformation for 5 meetings. The last, lesson plans 4were designed about probability and statistics for 5 meetings too.

Four student worksheets were also developed in the first draft. Student worksheets 1 were designed about rectangles and triangles. Student worksheets 2 were designed about linear equality and inequalitiesin one variable and social arithmetic. Student worksheets 3 were designed about transformation. Student worksheets 4were designed about probability and statistics.

Each student worksheets was containedthe following elements: a description of the contents of student worksheets, useful to give an overview to the students about the material in student worksheets; instruction to use the student worksheets, useful to provide information on how to learn student worksheets; basic competences which to be achieved by students; concept maps; table of contents, useful to facilitate students in their search for the material to be learned; learning activities which consisted oflearning purpose, information, critical thinking questions, exercises, and assignments. The information contained little information about the material studied. Critical thinking questions aimed to help students found facts, concepts, principles, and procedures mathematics about the materials. The exercise useful to provide opportunities for students to apply what they found and apply what was found in the new situation, and also assignment contained homework for students.

The formative assessment was conducted by experts to see the contents of the 1st draft before it tested. Validation was done by providing the instructional package and validation sheetsfor two lecturer of Mathematics Education, in Yogyakarta State University and one mathematics teacher in SMP N 1 Yogyakarta. Based on the results of validation could be known the valid criteria for lesson plans and student worksheets. Table 3 below presented the formative assessment by experts to instructional package.

TABLE 3. VALIDATION RESULTS OF INSTRUCTIONAL PACKAGE

Instructional Package	**Total Empiric Score**	**Category**
Lesson Plans	366	Very valid
Student Worksheets	295	Very valid
Total	661	Very valid

Table 3 stated that each instructional packagewas in "very valid" category. It means that the initial product of instructional package has already usedin tryoutafter revision based on the suggestion from the experts.

The last phase was assessment phase. Tryout about mathematics instructional package was conducted in this phase. Tryout consisted of the 1st and 2nd tryout. The 1sttryout wasconducted only limited to a few students. While the 2nd tryout was conducted on a class by implementing the instructional package developed in mathematics learning.

Ideally, all mathematics instructional packagewhich have been developed must be tested. However, tryoutin this research did not test the entire instructional packageof class VII on 2nd semester which has been developed in the development phase, but only in the material aboutlinear equality and inequalitiesin one variable and social arithmetic. It was done because of limited time, cost, and energy. Nevertheless, it was believed that the entire mathematics instructional packagewhich has developed have similar results with mathematics instructional package which has been tested.

Student assessment as a results of the 1sttryout indicated that the display of student worksheets was attractive; the characters of text, images, and background on student worksheetswere suitable; the instructions to use student worksheets were clear; the language in student worksheets could understandeasily; the place to write answers on student worksheetswas sufficient; and the number of exercises on the worksheet was sufficient. However, there were some suggestions from students before it used inthe 2nd tryout.

The result of the 2nd tryout indicated that the instructional package was "very practical" based on teacher assessment. Data from teacher assessment about instructional package could be seen in Table 4.

TABLE 4. RESULT OF TEACHER ASSESSMENT

Instructional Package	Score	Category
Lesson Plans	59	Practical
Student Worksheets	70	Very practical
Total	129	Very practical

Then, the percentage of implementation learning processwas 96% and the percentage of implementation POGIL was 97%. This means that the instructional package could be said to be "practical" based on the observation for learning process. Moreover, mathematics learningprocess by using student worksheets developed could be said to be "practical" based on the student assessment. Data result of student assessment could be seen in Table 5.

TABLE 5. RESULTOF TEACHER ASSESSMENT

Rated Aspect	Score	Category
Attractiveness	827	Practical
Easiness	791	Practical
Usefulness	390	Practical
Total	2008	Practical

Classically, learning mastery for knowledge reached 80% and for skills reached 83% based on the resultof the tests. Moreover, the result of questionnaires for religiosity showed that 100% students were in the very high category. Then, the result of questionnaires for attitudes showed that 31% students were in the very high category and 69% students were in the high category.So, it couldbe concluded that the lesson plans and student worksheets were "effective" based on the result of tests and questionnaires.

B. Discussion

The planning process was required to facilitate the achievement of mathematics learning objectives in learning. It was the preparation of instructional package consists of lesson plans and student worksheets.The instructional package would facilitate the teacher to implement mathematics learning process.

Curriculum 2013 focused on four competences. Those were religiosity, attitudes, knowledge, and skills. Students should have those four competences in mathematics learning which used scientific approach with implementation of inquirylearning. One of the learning strategies which were based on inquiry learning and suitable with Curriculum 2013 is POGIL. It could be implemented in mathematics learning to develop the competences of students. In a POGIL classroom, students worked in a team. The learning team constructed knowledge by working in a group with inquiry activities that has been specially designed in student worksheet. These activities could improve the students’ knowledge level by focusing on concept of development. Besides, the students could also apply their knowledge in new contexts. Moreover, the students learned to rely on thinking and performing skills rather than memorizing, and also developing positive relationships with other students.

Therefore, it was neccessary to develop mathematics instructional package with POGIL to 7th grade on the 2nd semester that was oriented to the students’competences in Curriculum 2013. The mathematics instructional package developed consisted of lesson plans and student worksheets in material about rectangles and triangles, linear equality and inequalities in one variable and social arithmetic, transformation, and probability and statistics. While it was implemented in mathematics learning process only on material about linear equality and inequalities in one variable and social arithmetic.

The learning activities in the lesson plansconsisted of introduction, main activity, and closing. In introduction the teacher explained about the learning purpose,motivated the students to study the material, and gave prerequisite material to help student studying the related material apperception. Main activity was an activity that contained POGIL steps including organized the student into some groups consists of

4-5 students, explore, discover, apply what they have discovered, apply what they have discovered in new situations, presented the discussion result, and held a quiz. In the closing activitythe teacher asked the students to conclude the material which have been learned in that day, made a reflection to the learning process, gavehomework to the students and told the next materials that will be studied in the next meeting.

The student worksheets with POGIL designed contains learning cycle. The learning cycle was consisted of three important phases. Those were exploration, invention, and application. Exploration phase in student worksheet could be represented by a few of information about the materials.I n the invention phase, critical thinking questions were given to the students. Those questions guided the students to discover some facts, concepts, principles, and mathematics procedures. There were three kinds of critical thinking question which can be used. Those were directed, convergent, and divergent questions. Directed questions point the student to obviously discovered about the information. Convergent questions required students to synthesize relationships from their new discoveries (and previous knowledge) and lead to the development of new concepts or deeper conceptual understanding. Divergent questions were open ended and did not have unique answers (Hanson, 2006).In the application phase, the students woulddo some exercises to apply what they have discovered and new contextual problems.

Furthermore, based on the validation results could be known that the instructional packagedeveloped has achieved "very valid" category. It could be known from the results of the validation lesson plans and student worksheets. Based on the validation results could be concluded that the lesson plans were "very valid" and so did the student worksheets. That description showed that the instructional package developed was already use for tryout.

Moreover, based on the results of tryout in the classroom could be known that the lesson plans and student worksheets developed have achieved "practical" category. It could be known from the results of teacher assessment, observation for learning process, and student assessment. Based on the results of teacher assessment about the lesson plans and student worksheets after learning in the classroom could be concluded that the lesson plans and student worksheets were "very practical". Based on observation for learning process could be concluded that the lesson plans and student worksheetswere "practical” with the percentage of implementation learning processwas 96% and the percentage of implementation POGILwas 97%. Based on the results of student assessment could be concluded that the student worksheetswere "practical". That description showed that the lesson plans and student worksheets developed, POGIL learning activities couldbe done well.

Then, based on the results of tryout in the classroom could be known that the instructional package developedhasachieved "effective" category. It could be known from the results of tests, questionnaires of religiosity, and questionnaires of attitudes. Based on the tests results could be concluded that the instructional package was “effective”. Classically, learning mastery for knowledge reached 80% and for skills reached 83% based on the resultof the tests. Moreover, the result of questionnaires for religiosity shows that 100% students were in the very high category. Then, the result of questionnaires for attitudes shows that 31% students were in the very high category and 69% students were in the high category.That description showed that the instructional package developed could be an alternative way for supporting the achievement of the 7th grade junior high school students’competences in Curriculum 2013.

The result of this research supportedthe previous research that has been conducted by other researchers. The research from [17] stated that the students problem solving ability taught using POGILwas better than the students problem solving ability taught using expository in circumference and area of circle material. The other research from [18] stated that students’ mathematics achievement, process skill, and students’ activity passed through the minimal criteria by individually or classically in mathematics learning process by using POGIL in differential material. Moreover, the other research from [19] stated that the mathematical communication skill passed through the minimal criteria by classically has been implemented POGIL using manipulatives and based on etnomathematics. Besides, the students’ attitude towards culture was better than before. On the other hand, the result of this research also supported other development research from [20] stated that the pythagoras theorem instructional package such as syllabi, lesson plans and student worksheets with ideal approach assisted GeoGebra was valid, practical, and effective through 4-D developing model from Thiagarajan, Semmel, & Semmel.

Based on the description above, it could be concluded that the mathematics instructional package with POGIL that wasoriented to the 7thgrade junior high school students' competences in Curriculum 2013 on the 2nd semester has been proven validity, practicality, and effectiveness. Thus, the mathematics instructional package was consisted of lesson plans and student worksheets could use in the learning activity.

IV. CONCLUSION AND SUGGESTION

Based on the result of the research and discussion above, it can be concluded that the quality of mathematics instructional package with POGIL that was oriented to the 7th grade junior high school students' competences in Curriculum 2013 on the 2nd semester was valid, practical, and effective.

Some suggestion to the mathematics teachers, they can use mathematics instructional package with POGIL which has been developed in mathematics learning process because it has been valid, practical, and effective. It also can be used as a reference forthemto compile mathematics instructional package that is used to develop students' competences in the class. Futher suggestion for the researchers who are interested in development research can be develop mathematics instructional package in other materials, other attitudes variables, or for other grade levels.

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ME – 26

The Development of Interactive Learning Media to Explore The Students' Mathematical Creative Thinking Ability

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Abstract - The purpose of this study was to design an interactive learning media, identify the beginning and end of the ability of creative thinking mathematical students, excavate student response to the implementation of media interactive learning, analyze the difficulties of creative thinking students. The method used were Research and Development, with the steps: identify of teaching material, organize media interactive learning, considered by the experts, try out media interactive learning and research instruments, examine the pre-test and post-test of mathematical creative thinking, implement of interactive learning media in Mathematics Capita Selecta course, distribute questionnaires and interviews. Data collection techniques included: media interactive learning test, mathematical creative thinking ability tests, questionnaires and interviews. The research instruments are mathematical creative thinking ability tests, questionnaires and interviews sheet. The population in this study were all students majoring in mathematics education semester of academic year 2015-2016. Sample used were cluster random sampling technique with 2 classes. The results showed that media interactive learning in Mathematics Capita Selecta course could be implemented. The pre-test showed that students' mathematical creative thinking was low, but the post-test showed that students' mathematical creative thinking performed in an medium level. Students' difficulties in mathematical creative thinking were on the flexibility and orginality indicators. In addition, students feel happy, challenged and motivated to learn in Mathematics Capita Selecta course.
Keywords: *Interactive Learning Media, mathematical creative thinking ability, difficulty thinking*

I. Introduction

Along with the demands of advanced science and technology, there are continuous efforts to improve the quality of education in Indonesia, especially in the field of mathematics education. Require new breakthroughs in curriculum development, human resources, learning and innovation in meeting the educational facilities. In connection with the development of human resources, the lecturer gives a very important role in providing supplies to students as future teachers through lectures. According to Festus (2013), the activity based-learning pedagogy is expected to make students feel responsible for their learning and support their own personal development. The use of instructional media is one way to lecturers so that students can understand the concepts that are presented, besides that lectures more interesting and fun so that students can learn more optimally. Various media that can be used in the lecture, including computer-based learning media or Information Technology (IT). Ali (2009) stated that one computer-based learning media is an interactive learning media, learning media is more interesting and the material is abstract can be visualized in animation media in accordance with actual conditions in the field, following the development of science and technology so that the motivation of students to learn and build knowledge becomes easier to do. One computer-based learning media that are popular today is an interactive medium. The use of interactive media in the learning of mathematics in the classroom is expected to attract interest and motivate students to improve their achievement. According to Kusuma (2009) in general, students have a high curiosity to try something new, including the technology in this decade is loved by teenagers and school children.

Lectures by using interactive learning media is one form of realization of the curriculum in Mathematics Education courses, so that students can learn actively on the Mathematics Capita Selecta course, understand the concepts and be able to develop creative thinking skills. Now, lectures on Mathematics Capita Selecta course already using computer-based learning media but only a powerpoint media that looks less

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attractive and not interactive, so students seemed less motivated to learn. Currently each class at mathematics education department of Siliwangi University already available means to support computer-based learning. In this condition, the lesson should no longer be a tedious thing, as a few decades ago. Thanks to the development of information technology so rapidly, teaching materials can be presented with sounds and images are dynamic, not boring, as well as solid information. Therefore, the development of Information and Communication Technologies (ICT) based learning is expected to improve the quality of the learning process in the classroom. United Nations Educational Scientific and Cultural Organization (UNESCO, 2002) states that the use of ICT in learning has three objectives: to build a knowledge-based society habits like problem solving, communication skills, ability to find and manage information, turn information into new knowledge and share them with others, and to improve the effectiveness and efficiency of the process learning.

To foster the spirit of learning students, lecturers are required to create learning more interesting and innovative, so as to encourage the learn optimal learning and can develop the capacity to think. Efforts to create exciting and innovative learning and can facilitate develop creative thinking abilities, that is mathematics lectures using interactive learning media. Results of research Kusumah et al. (2008, 2009) and Wardani et al. (2013) that: a computer-based interactive learning can be presented in an interesting, efficient, and effective interaction patterns tutorials, simulations, or games; increase the ability of reasoning, communication, connection, problem solving, critical thinking, and creative thinking mathematically through learning computer media better than students in the regular classroom learning; implementation of the use of computer media can significantly increase positive attitudes and interests of students in learning mathematics.

Mathematical creative thinking ability toward Guilford model structure of human intelligence which consists of several factors including the operation of divergent product includes fluency, flexibility, and elaboration. Then Torrance (Hudgins et al., 1983) add components originality as a concept fundamental to the components of divergent thinking so that there are four components namely divergent thinking fluency, flexibility, elaboration, and originality. Evans (1991) suggested that components of divergent thinking: the problem of sensitivity is the ability to recognize the existence of a problem or ignore the misleading fact to recognize the real problem; Fluency is the ability to build a lot of ideas are easy; flexibility refers to the ability to build a diverse ideas; Originality is the ability to generate ideas that are unusual or extraordinary, solve problems in ways that are unusual or non-standard. Starko (1995) and Munandar (2004) suggests that the model structure of the intellect of Guilford is a model of intelligence complex, consisting of 180 components are formed through the combination of content, products, and operations. From the opinions above about divergent thinking of Guilford could conclude that line divergent creativity thinking. Understanding creativity according to Jones (1972) is a combination of flexibility, originality, and sensitivity. Hudgins et al. (1983) provide an understanding of creative thinking is a process that is productive in the sense that the creative thinking to produce a new idea or product.

This researh to design, develop and implement Adobe flash interactive learning media at Mathematics Capita Selecta Course to explore mathematical creative thinking ability. The purpose of this research: design, develop and implement interactive learning media at Capita Selecta Mathematics Course; evaluating the feasibility of interactive learning media based on expert assessment of materials and interactive media and empirical testing, measuring mathematical creative thinking abilities after using interactive learning media.

II. Research Methodology

This research is the depelovment with used Research and Depelovment method. The population are all students majoring in mathematics education semester of academic year 2015-2016. Sample used is cluster random sampling technique as much as 2 classes as many as 110 students. Instruments in this research: open questionnaire, a questionnaire is closed, and questions of mathematical creative thinking ability tests. In developing interactive learning media includes 4 stages: define, design, develop , and implementation. Each stage is explained as follows:

a. Stage define include: study literature, course material identification, analyze the characteristics of students, formulate learning objectives, and designing test questions mathematical creative thinking abilities. At this stage, analyze and identify all the needs required in designing interactive learning media and creative thinking abilities make about mathematics.

b. Stage design includes: the early design of interactive learning media and create questions test ability to think creatively about mathematics as much as 5. At this stage to make a preliminary draft media interactive learning using Adobe Flash program and about the mathematical creative thinking abilities will be tested.
c. Stage develop include: consideration of subject matter experts and media, data analysis and revision, instructional media and about the test results of the revision, the trial is limited to students, data analysis results of limited testing, test empirically, the feasibility of interactive learning media and about the test's ability to think creatively mathematics. At this stage, an evaluation by subject matter experts and media, limited trial against 9 students to see contant validity and face validity, then the empirical testing of students outside a sample of 30 people. The goal is to get advice and feedback to revise media interactive learning and creative thinking abilities about mathematics so that used in this research.
d. Stage Implementation includes: pretest, interactive learning media used in lectures, post-test mathematical creative thinking abilities, distributing questionnaires and interviews to students.

Interactive learning media assessment by experts include indicators: the type face used, operating instructions, menu navigation, completeness menu display, menu design overall, musical accompaniment, animated illustrations, color harmony, clarity and editorial images, use the button, and interactive. After media interactive learning and creative thinking abilities about mathematics is declared fit for use, and then implemented in the Mathematics Capita Selecta course during one semester. Each indicator broken down into several aspects of the measure. Scores of interactive learning media assessment rubrics as follows:

Table 1. Rubric Score Assessment Interactive Learning Media

Assessment Criteria	Score
Choose one of assessment criteria	1
Choose two of assessment criteria	2
Choose three of assessment criteria	3
Choose four of assessment criteria	4

Questionnaire for students include positive statement and negative statement. Selection positive statement: strongly agree (5), agree (4), disagree (2), strongly disagree (1) and negative statement: strongly agree (1), agree (2), disagree (4), strongly disagree (5). The ability to think creatively mathematical measure includes five indicators: sensitivity, fluency, flexibility, elaboration, and originality. The following rubric score mathematical creative thinking abilities.

Table 2. Rubric Score Assessment Mathematical Creative Thinking Ability

Number	Indicators	Aspect Measured	Score
1	Sensitivity	Did not answer or answered incorrectly	0
		Detecting deficiency and advantages of the problem but it is not clear	1
		Detecting deficiency and advantages of the problem but there is no mistake	2
		Detecting deficiency and advantages of the problem but not completely	3

		Can detect problems deficiency and advantages with complete and correct	4
2	Fluency	Did not answer or answered incorrectly	0
		Asking just one idea to solve the problem	1
		Propose various ideas solve the problem but there is a mistake	2
		Propose various ideas solve the problem but incomplete	3
		Propose various ideas solve the problem completely and correctly	4
3	Flexibility	Did not answer or answered incorrectly	0
		Solve the problem in only one way, but incomplete	1
		Solve problems with just one complete and correct way	2
		Solve the problem in various ways but incomplete	3
		Solve the problem by various means complete and correct	4
4	Elaboration	Did not answer or answered incorrectly	0
		Completing problem only small fraction	1
		Completing problem but there are still many deficiency	2
		Completing problem but less complete and clear	3
		Completing problems so complete and clear	4
5	Originality	Did not answer or answered incorrectly	0
		Solve problems by using standard formula	1
		Solve the problem in his own way but it is not clear	2
		Solve the problem in his own way but not yet completed	3
		Solve the problem in his own way and true	4

III. Results and Discussion

The validate interactive learning media, expert material selected 2 mathematics education lecturers and 2 lecturers computers, both criticism and suggestions, which are summarized as follows:

a. The material was as it should be delivered.
b. There are still some wording should be corrected, should be short, dense, clear and straightforward
c. Operating instructions and the flow should be more clear, systematic, logical and easy to understand; navigation menu is complete.
d. Less harmonious blend of colors should be more contrast, the look of each slide should be more interesting, interactive to be discreet in order to increase interest in learning and curiosity, backround more interesting and not boring, not too loud background music, interesting and appropriate.
e. Operating instructions presented in clear and unambiguous, straightforward, and easy to understand.

f. Should be from menu to menu; from one concept to another concept; from the beginning, middle and end should be interrelated.

Based on input and advice from subject matter experts and interactive learning media, then discuss with programmers to improve software interactive learning media. Once repaired, then validated again by the experts, so subject matter experts and media stated could be implemented. The following are examples of page views:

Figure 1. Examples of Display Interactive Learning Media

The next tested on 30 students who have already learned the 7th semester Capita Selecta Mathematics course previously tested but limited to 9 students representative of the ability of high, medium, and low to see the face validity and content validity. In general, the students argued against interactive learning software media that is semantically understandable, attractive colors, and display instructions are clear, but the time available is not sufficient. During the trial progresses, researchers observed the activity of students. Based on observations obtained some information: enthusiastic students using interactive learning software media, a discussion with a friend who was beside him, if anyone does not understand to ask. There are constraints experienced, some unresolved issues, but his time is up. Based on empirical testing, interactive learning media eligible for use in lecture.

Furthermore, an interactive learning media used in the course for 1 semester. Before to the implementation of interactive learning media in lectures, lecture held at the beginning of the pre-test mathematical creative thinking abilities against 110 students obtained a mean 12.21 from maximum score of 20 with the following results:

Table 3. Pre-test Results of Mathematical Creative Thinking Ability

Number	Criteria	Number of Students	Percentage (%)
1	Very High	2 Person	1.82
2	High	5 Person	4.54
3	Medium	10 Person	9.09
4	Low	93 Person	84.55
Sum		110 Person	100.0

After all the lectures is finished, then held the post-test mathematical creative thinking abilities obtained a mean 16.80 with the following results:

Table 4. Post-test Results of Mathematical Creative Thinking Ability

Number	Criteria	Number of Students	Percentage (%)
1	Very High	9 Person	8.18
2	High	27 Person	24.55
3	Medium	53 Person	48.18
4	Low	21 Person	19.09
Sum		110 Person	100.0

Furthermore further explored means on each indicator of the mathematical creative thinking abilities, with the following results:

Table 5. Means Post-test of Mathematical Creative Thinking Abilities In Every Indicators

Number	Indicators	Means
1	Sensitivity	2.9
2	Fluency	3.3
3	Flexibility	2.3
4	Elaboration	3.1
5	Originality	1.8

At the end of the course distributing questionnaires to students with the aim of asking in response to the use of this interactive learning media. The response of students to interactive learning media are summarized as follows:

a. The sentences short, dense, and clear; color interesting and not boring; can facilitate self-learning.
b. The procedure of the menu is clear and can be followed, helping to more easily understand the concept, but the time not enough.
c. The problem that is written is clear, but sometimes confused finish so curious to continue to finish.
d. The concept is found through the problem, and completion is full of challenges, linking with the previous concept.
e. Problems and questions provided are varied that no question of easy, moderate and difficult.

Student response to interactive learning media, problems experienced that time provided insufficient, the problems have not been resolved. Based on the results of the validation of the subject matter experts and interactive learning media, limited testing and test empirically the students, as well as the questionnaire to the student can be concluded that interactive learning media is feasible to implement in the lecture Mathematics Capita Selecta course for one semester though in terms of the time provided less adequate. This is because the software media interactive learning, facilitate students find the concept (not notified), lecturer just drive away. If students are having problems, not directly notified but was directed to use the referral question. Thus the automatic will invariably take longer than learning directly notified.

Noting the results table pre-test creative thinking abilities in classical mathematics students are at low criteria, although individually 2 students are at very high qualification and 5 students were in qualifying frequency. Achievement of this kind naturally, because the students have not been trained mathematical creative thinking. Based on the results of post-test that mathematical creative thinking ability students are at medium levels, meaning the ability to think creatively mathematics of students increased from a low level to medium although the increase is less significant. This is consistent with the results of research Kusuma (2009) and Wardani et al. (2013). Judging from the creative thinking abilities mathematical means every indicator, it can be concluded that the students had difficulty in orginality and flexibility indicators. Based on interviews on students, because thinking about orginality use that is not standard or common or not to use the formula, student difficulties in solving problems in their own way. Similarly, in a matter of flexibility, confused students solve problems in 2 ways. On two indicators, students are not familiar with how to solve the problem alone and in various ways. This is consistent with the results of research Ratnaningsih (2010), the results of research Patmawati dan Ratnaningsih (2015) that students have difficulty in mathematical creative thinking abilities in the indicator flexibility and originality. After the implementation of the post-test, students are given a questionnaire and conducted interviews to determine the interest of students to use interactive learning media in lectures. The results of questionnaires and interviews with media use interactive learning: learning interesting and fun, motivated and enthusiasm for learning, challenging, but the time available is not enough. Noting the results of pre-test and post-test, Interactive learning media is able to explore mathematical creative thinking abilities although the results have not been up.

IV. Conclusion

This research obtained conclusion: based validation experts and media interactive learning materials, empirical testing, and student responses through questionnaires and interviews that the design of interactive learning media could be implemented at Mathematics Capita Selecta Course. Mathematical creative thinking ability of students increased from a low level into a medium level. Students having difficulty in the ability to think creatively mathematical indicator flexibility and originality. Students get excited and motivated to learn using interactive learning media. Interactive learning media is able to explore creative thinking abilities mathematics although the results have not been up.

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ME – 27

Guided Discovery:
A Method to Minimize The Tendency of Students' Rote-Learning Behavior in Studying Trigonometry

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***Abstract*—** In Indonesia, trigonometry is one of the topics that has been taught in senior high school level which contains a lot of formulas and concepts that have to be understood by the students. Formulas and concepts could be a cognitive burden for them, especially when the learning process does not involves them actively. So that, it will emerge a tendency for pupils to learn the formulas by rote. Teacher cannot take it for granted since this learning process will become meaningless. Therefore, Guided Discovery teaching method is considered to be needed as one of the alternative solutions to reduce the tendency of rote-learning behavior, since this method enables the teacher to engage students into a learning process of finding trigonometry formulas through reinvention steps provided by this method. In addition, this method require students' prior knowledge along the reinvention process, so that the learning process becomes more meaningful. The purpose of this article is to describe the implementation steps of Guided Discovery method in trigonometry learning process to minimize students' rote-learning behavior. The method used in this paper is literature review. This paper will explain the theories of Guided Discovery, rote-learning behavior, and how the method will minimize the learning behavior.

Keywords: *guided discovery, rote-learning behavior, trigonometry*

I. INTRODUCTION

Trigonometry is a branch of mathematics that concerns on the elements of triangle such as sinus, cosine, tangent, secant, cosecant, cotangent, and its applications [1]. Many concepts are developed from these elements to enable people in solving their daily-life problems, namely in a construction, in music, in economy, and etc. Therefore, we believe that trigonometry need to be understood as early as possible by the people, especially in high school level. In Indonesia, based on curriculum of 2013, topic of trigonometry is formally taught in senior high school level. At grade X Science Program, the students learn the topic of ratios, functions, equations, and identities of trigonometry. While for topics of trigonometry derivative formulas and its uses are taught at grade XII Science Program.

Specifically in the topic of trigonometry derivative formulas and it uses, the students will learn at least 25 formulas which whatsoever the way they have to understand these, plus the concepts and formulas that they have to remember when they learned this at grade X. Exactly, the demand to understand and to remember those number of formulas and concepts will be not easy for the pupils. So that, it emerges a tendency of the students will learn it by rote since this is the easiest way to put any information into their brain. This tendency appeared because some factors including the teacher factor, the student factor, and the learning resource factor.

From the teacher factor, the tendency can be caused by the way teacher explains, teaches, and delivers the material. There is a possibility the teacher uses a direct teaching method in explaining the way to find the formulas without giving any chance for the students to get involve during the learning process. From the student factor, as we mentioned before, it can be due to the cognitive burden arises in their mind when they are obliged to understand and to remember all of the concepts and the formulas, so they tend to use rote learning method to ease the way they understand the materials. While from the aspect of learning resources, a lot of mathematics books provided in bookstores merely give constructed steps without allocating any space for the students to be engaged in the process of finding the formulas. We can figure

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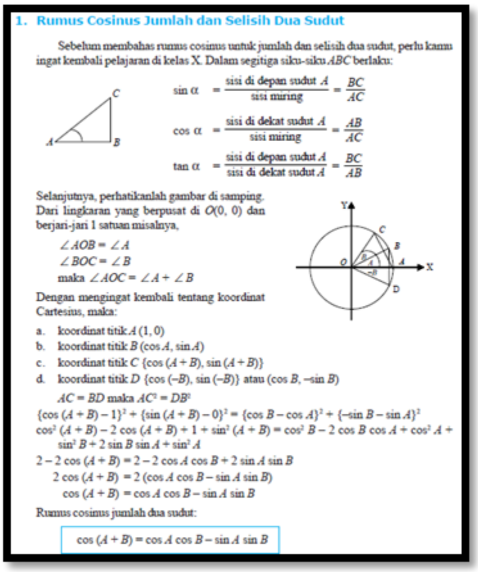
this condition out by observing the following samples of Indonesian Mathematics Electronic School Book (ESB):



1. Rumus Cosinus Jumlah dan Selisih Dua Sudut

Sebelum membahas rumus cosinus untuk jumlah dan selisih dua sudut, perlu kamu ingat kembali pelajaran di kelas X. Dalam segitiga siku-siku ABC berlaku:

$$\sin\alpha = \frac{\text{sisi di depan sudut } A}{\text{sisi miring}} = \frac{BC}{AC}$$

$$\cos\alpha = \frac{\text{sisi di dekat sudut } A}{\text{sisi miring}} = \frac{AB}{AC}$$

$$\tan\alpha = \frac{\text{sisi di depan sudut } A}{\text{sisi di dekat sudut } A} = \frac{BC}{AB}$$

Selanjutnya, perhatikanlah gambar di samping. Dari lingkaran yang berpusat di $O(0, 0)$ dan berjari-jari 1 satuan misalnya,

$\angle AOB = \angle A$
$\angle BOC = \angle B$
maka $\angle AOC = \angle A + \angle B$

Dengan mengingat kembali tentang koordinat Cartesius, maka:

a. koordinat titik A $(1, 0)$
b. koordinat titik B $(\cos A, \sin A)$
c. koordinat titik C $\{\cos(A+B), \sin(A+B)\}$
d. koordinat titik D $\{\cos(-B), \sin(-B)\}$ atau $(\cos B, -\sin B)$

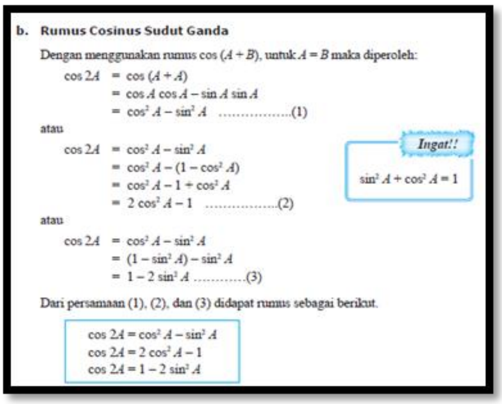
$AC = BD$ maka $AC^2 = DB^2$

$$\{\cos(A+B)-1\}^2 + \{\sin(A+B)-0\}^2 = \{\cos B - \cos A\}^2 + \{-\sin B - \sin A\}^2$$
$$\cos^2(A+B) - 2\cos(A+B) + 1 + \sin^2(A+B) = \cos^2 B - 2\cos B\cos A + \cos^2 A + \sin^2 B + 2\sin B\sin A + \sin^2 A$$
$$2 - 2\cos(A+B) = 2 - 2\cos A\cos B + 2\sin A\sin B$$
$$2\cos(A+B) = 2(\cos A\cos B - \sin A\sin B)$$
$$\cos(A+B) = \cos A\cos B - \sin A\sin B$$

Rumus cosinus jumlah dua sudut:

$$\boxed{\cos(A+B) = \cos A\cos B - \sin A\sin B}$$

FIGURE 1. THE SAMPLE OF ESB IN FINDING THE FORMULA OF COS (A + B)



b. Rumus Cosinus Sudut Ganda

Dengan menggunakan rumus $\cos(A+B)$, untuk $A = B$ maka diperoleh:

$$\cos 2A = \cos(A+A) = \cos A\cos A - \sin A\sin A = \cos^2 A - \sin^2 A \quad \ldots\ldots(1)$$

atau

$$\cos 2A = \cos^2 A - \sin^2 A = \cos^2 A - (1-\cos^2 A) = \cos^2 A - 1 + \cos^2 A = 2\cos^2 A - 1 \quad \ldots\ldots(2)$$

Ingat!!

$\sin^2 A + \cos^2 A = 1$

atau

$$\cos 2A = \cos^2 A - \sin^2 A = (1-\sin^2 A) - \sin^2 A = 1 - 2\sin^2 A \quad \ldots\ldots(3)$$

Dari persamaan (1), (2), dan (3) didapat rumus sebagai berikut.

$$\boxed{\begin{aligned}\cos 2A &= \cos^2 A - \sin^2 A\\ \cos 2A &= 2\cos^2 A - 1\\ \cos 2A &= 1 - 2\sin^2 A\end{aligned}}$$

FIGURE 2. THE SAMPLE OF ESB IN FINDING THE FORMULA OF COSINE 2A

When we observe the figures above, the book directly gives the way to find the formulas, then emphasizes it by "boxing" the formulas. The first concern is, as an appropriate textbooks in general, this book does not involve student participation in finding the formula in question. The next concern is the box sign given on the formulas that giving a possibility for the students to pay their attention not on the process of finding the formula, but straightly on the formula. So that if the students want to memorize the formulas, this book indirectly "facilitates" them by pointing some important parts to be memorized, when in this case is the formulas. From those concerns, this can be seen that the available learning resource still less engaging the pupils actively during the learning process of finding trigonometry formulas. Therefore, the tendency of rote-learning will be inclining.

Basically, rote learning is the easiest way to take an update of what we learn. However, the information learned by the students will be easily forgotten since there is nothing "memorable" left in their mind. Hence, the learning process will become meaningless. Ausubel in [2] says, "…if the learner's intention is to memorize it verbatim, i.e., as a series of arbitrarily related word, both the learning process and the learning outcome must necessarily be rote and meaningless". By relating to Indonesian Curriculum 2013, rote-learning behavior does not support the aim of this curriculum which is the learning process of curriculum 2013 should be *to get to know*, not *to be told*. This means, in the purpose of making the class becomes less rote learning but more meaningful, so the students should be actively finding out new information using their cognitive skill and prior knowledge, not in the opposite way.

Hence, we need a teaching method to minimize the students' tendency of memorizing the material they have learned so that the learning becomes more meaningful. The method should be able to engage the pupils actively in the process of constructing trigonometric derivative formulas. Therefore, they can experience the same condition as when the formulas were invented for the first time. This experience will be memorable in the minds of the students where they understand the way the formula was constructed. So when one day they forgot the formula they have learned, they will be able to reconstruct these formulas with the memory that sticks in their minds. Therefore, one of the teaching method that is appropriate to this condition is Guided Discovery teaching method. Guided Discovery is a teaching method that can involve the students actively to find new knowledge based on their prior knowledge under the guidance of the teacher. Through this method, the student involvement in finding the trigonometric formulas will be accommodated properly.

Based on the description of the background above, this paper offers a Guided Discovery teaching method in minimizing the tendency of students' rote-learning behavior in studying trigonometry. The aim of this paper is to explain the theories of Guided Discovery, rote-learning behavior and the way this method minimize the tendency of rote-learning behavior theoretically. The method used in this paper is literature rivew.

II. THEORITICAL FRAMEWORK

A. *Guided Discovery*

Before we discuss guided discovery teaching method, we need to explore the essence of this teaching method. Based on the history, [3] state that the first example of Discovery method was given by Plato about the dialogue between Socrates and a young slave where by the time this method is known as Socratic Method. According to Bruner in [3], he says, "discovery is a process, a way of approaching problems rather than a product or particular item of knowledge". In a short words, we can say that learning by discovery is learning to discover, where the students face a problem and they will find the way to solve it. According the definition [4], "Discovery learning is intentional learning through supervised problem solving following the scientific method of investigation". Whereas according to [5], "Discovery learning is hands-on, experiential learning that requires a teacher's full knowledge of content, pedagogy, and child development to create an environment in which new learnings are related to what has come before and to that which will follow". If we drag a correlation based on the three experts (Bruner, Moore, and Abruscato) statements, then we can conclude that Discovery learning is a learning process through a process of problem solving that is arranged from investigation steps to discover new information or skills for the students.

Furthermore, Moore explains that Discovery learning can be done in three steps, depends on the solution to the problem. First, a discovery that is guided carefully (Guided Discovery). Second, a discovery that is guided accordingly (Modified Discovery). Third, a discovery that is limited only on a supervision (Open Discovery). Since our focus only on the high school students ability, so the level of Discovery learning that is chosen to be discussed is Guided Discovery.

According to [6], "Guided Discovery was the name to hand-on activities and laboratory investigation that led the learner to a predetermined or a predictable data set or response". While [7] says that Guided Discovery is a teaching method based on inquiry, a constructive teaching theory within a problem solving situation where the student use their prior knowledge and experiences to find facts, correlations, and truths to be learned. Hence, based on the two experts' statement we can draw a conclusion that Guided Discovery method is a method to direct students to construct their knowledge through a discovery of new concepts and knowledge under teacher guidance.

As a teaching method, exactly Guided Discovery has advantages and disadvantages. The following table will mention some of them according to Marzano in [8]:

TABLE 1. ADVANTAGES AND DISADVANTAGES OF GUIDED DISCOVERY METHOD

Advantages	**Disadvantages**
1. Students will actively participate during the learning process. 2. Instill well as foster an attitude of inquiry. 3. Support students' problem-solving	1. Not all of the students can follow the lessons in this way since some of them are still familiar and easily understood by the lecturing method. 2. Not all topics are suitable delivered with

skill. 4. Provide a space for interaction among the students, as well as students to teachers, in order to train the students to communicate their idea properly and correctly. 5. The subject being studied can achieve a high level of capability and longer lasting because the students are involve to find new knowledge.	this method. Generally, topics related to the principles of the model can be developed with Guided Discovery.

Besides the advantages and the disadvantages, we also can find cognitive benefits for the students by implementing Guided Discovery teaching method in class. Here are some of them [9]:

1. It encourages analytic learning.
2. It exploits learners' cognitive skills.
3. It improves critical thinking skills.
4. It involves students in problem solving tasks.
5. It helps learners become aware of and articulate their mental process.
6. Learner actively in the learning process.
7. Learners understand and remember better what they have work out for themselves.

Indeed, this method has main objective in term of developing students' capability i.e. according to [10], "The prime objective of these (guided discovery) activities is to have students discover, and/or self-construct, the scientific/technological concept embedded in the activities as students do the activities'. In addition in the same page, [10] reminds us that although this activity has been in the design as much as possible, there will be students who do not follow the lesson plan that has been designed by the teacher. Thus, the teacher has to be flexible during the learning process. Here are the steps of Guided Discovery teaching method [11]:

1. Teacher determines the task criteria such as giving problems. Then the students find solutions for the problems. The problem that has been given should contain clues about things students need to do, namely students find the solutions of the problems by themselves.
2. Smart students will have possibilities to find the answer by themselves without teacher's guidance. Otherwise, students who incapable to find the answer need to have their first guidance by the teacher. This guidance should be in form of simple questions.
3. Having first guidance, the students who able finish the problem should check their answer by using the provided data. While for the student who cannot find the answer, they get second guidance by the teacher. The guidance is in form of questions to arrange the data that already available. The aim of this guidance is to get samples of the answer from some of the provided problems.
4. After the second guidance has already given, the students who succeed getting the answer of the provided problems should check their answer using the data that already exist. The students who do not able to find their answer get the third guidance from the teacher which in form of additional data that is arranged into a list. The expected goal of this third guidance is to make students can find the answer. If by giving this additional data the student do not find the answer yet, the teacher have to give another short guidance verbally for the students to get the expected answer right away.
5. Students are required to check their answer after they get their third guidance.
6. After they check their answer, they use it to finish the task criteria.
7. Students find the answer from what they do in task criteria.
8. The answer from the task criteria is still conjectural, so a proof is needed to verify it. So the teacher must give the answer a confirmation whether the students are correct or not.
9. Teacher gives enrichment to the students in form of applicable problems. It is expected in solving the problems, they can use the concept they just have got.
10. If the student can answer the problems correctly, so it can be said that they succeed constructing new knowledge about a concept that they have learned.

While according to Soedjadi cited in [11], says that there are 6 steps that need to be done to complete a learning by Guided Discovery method:

1. Giving Problem
   Students required to understand the given problem.

2. Data Development
   Students required to seek or pointing the possibilities other data as the continuity of the known data.
3. Data Arrangement
   Students required to arrange the data obtained for the first step and second steps in a list.
4. Extra Data
   Students required to add extra data as the continuity of the known data if the expected pattern is not obtained yet.
5. Answer The Problem
   Students answer the problem in the first step.
6. Checking The Answer
   Students required to see the truth of the general pattern that is obtained with some available data.

In this instructional method, the teacher becomes a facilitator, who guides students in the right directions so as to avoid misunderstanding of the rules. Hence, there are some things that must be considered during the use of this method in the learning process, as outlined by Michael Swan [9].

1. The rules should be true.
2. The rules should show clearly what limits are on the use of a given form.
3. The rules need to be clear.
4. The rules ought to be simple.
5. The rules need to make use of concepts already familiar to the learner.
6. The rules ought to be relevant.

B. Rote-Learning Behavior

The definition of rote learning is a learning by memorizing information repeatedly [12]. The idea of this method is the more we repeat the information, the more information we will remember in verbatim. Experts generally agree to a certain point that rote learning is necessary and important. This method is commonly used when fast retention is required, such as memorizing phone number, someone’s name, or post number. Or in education, when students need to remember the alphabets and how to spell the words.

Indeed, there must be pros and cons about the use of this method. For the cons, some believe that by having rote-learning method as a way to learn new information, some students may forget the facts that they have learn after doing test, and may not full understand the concepts to begin with [13]. For instance, when students are studying about trigonometric formulas for the sake of a test on the next day, whereas they did not study well before, so they realize that they need to remember all formulas in a short time. They will probably not have a very deep understanding of the actual meaning of the formulas. They will then likely forget all the other facts shortly anyway.

In the other hand, some pros believe that rote learning method will build the foundation, so students can learn more difficult concepts. For example, firstly students have to acknowledge the shape of triangle, square, trapezium, and circle, then they begin to find area of those shapes.

According to [14], the revised taxonomy includes six cognitive process categories, one most closely relates to retention (Remember) and the other five relates to meaningful learning (Understand, Apply, Analyze, Evaluate, and Create). This means that when the learning process merely focus on memorizing the material, so this will become meaningless.

C. Trigonometry in Senior High School

Based on Indonesian curriculum of 2013, topic of trigonometry has been taught at grade X and grade XII natural science program. At grade X, students will learn about angle, degree, radian, quadrant, ratios (sinus, cosine, tangent, cotangent, cosecant and secant) and trigonometry identities. While at grade XII natural science program, students will learn compound angles formulas, double-angle and half-angle formulas, multiplication formulas for sinus and cosine, addition and subtraction formulas of sinus and cosine. Those materials are formulated into basic competences presented as follows:

TABLE 2. BASIC COMPETENCES OF TRIGONOMETRY BASED ON CURRICULUM OF 2013

Grade	Basic Competences
X	3.15 Understanding the concept of trigonometric ratios in right-angled triangle through the investigation and discussion about the ratios of corresponding sides in some congruent right-angled triangles. 3.16 Determining the properties and relationship among trigonometric ratios in a right-angled

	triangle. 3.17 Understanding and determining the relation of trigonometric ratios from an angle in every quadrant, choose and implement it to solve problems in mathematics. 3.18 Understanding the concept of trigonometric function and analyze its graphic function as well as determining the relation of value of trigonometric function from special angles. 4.15 Applying trigonometric ratios to solve problems. 4.16 Presenting trigonometric graphic function.
XII	3.6 Describing the identity of sinus summation, identity of sinus subtraction, identity of cosine summation, identity of the different to be implemented in problem solving. 4.6 Presenting and analyzing the identity of sinus summation, identity of

III. DISCUSSION

As what has been described before, in which rote-learning is a method of learning that can lead students to a meaningless learning process, it is good if we discuss the definition and conditions of meaningful learning before we discus much about how the method of Guided Discovery can be an alternative solution in minimizing the tendency of rote learning.

Meaningful learning always be related to Ausubel, a psychologist who advance a theory which contrasted meaningful learning from rote learning. He believes that learning of new knowledge relies on what is already known [15]. This means that in order to construct new knowledge, it is required students' prior knowledge in order they can easily relate this new knowledge with what is already familiar in their minds. So that, the new knowledge will stick around longer in students' minds. Next, Piaget in his theory of cognitive development suggested that human's unable automatically understand and use information that they have been given because they need to construct their prior knowledge through prior personal experiences to enable them to create mental image [15]. Where in a short words, he says that human learn by constructing their own knowledge. Therefore, to construct a prior knowledge through prior personal experience, students need to be involved actively during the learning process. Because when they solely memorizing the material, they do not make any way to relate what they have known to what they going to know.

Following table explains the different between meaningful learning and rote learning according to Ausubel [16]:

TABEL 3. MEANINGFUL LEARNING CONTRASTED WITH ROTE LEARNING

Meaningful Learning	**Rote Learning**
1. Non-arbitrary, non-verbatim, substantive incorporation of new knowledge into cognitive structure.	1. Arbitrary, verbatim, non-substantive incorporation of new knowledge into cognitive structure.
2. Deliberate effort to link new knowledge with higher order concepts in cognitive structure.	2. No effort to integrate new knowledge with existing concepts in cognitive structure.
3. Learning related to experiences with events or objects.	3. Learning not related to experience with events or objects.
4. Affective commitment to relate new knowledge to prior learning.	4. No affective commitment to relate new knowledge to prior learning.

If we associate it with topic of trigonometry taught in schools, the formulas and concepts being taught is easy to "rediscover" by the students. This is because students already have their prior knowledge enough to find those formulas and concepts. For instance, in the material of trigonometric ratios in right-angled triangle at grade X, students already studying the properties of right-angled triangles earlier when they were in junior high school. So as to introduce the concept of sine (as a comparison of the length of front side of the corner and the hypotenuse of right-angled triangle), or cosine (as the length ratio of the next side of the corner and the hypotenuse of right-angled triangle) can be done easily. Another example, the material of trigonometric derivative formulas to formula of sin $(\alpha \pm \beta)$ which can be found easily using the trigonometric formula to determine the area of any triangle they have learned at grade X. Therefore, it is very unfortunate if students only know (by memorizing process) without understanding the meaning and the origins of the trigonometric formulas and its concepts. The impact is that when they are oblivious to these formulas they cannot re-construct these formulas, or they merely know the formulas and concepts but they cannot use it to solve problems. So, meaningful learning is a must in studying trigonometry by the students.

Based on those reasons, Guided Discovery is considered to be an alternative solution to lead the learning process into a meaningful learning process by minimizing the tendency of students learn by rote. This is because:

1. Guided Discovery addresses some of the drawbacks associated with both deductive and inductive instruction as it is essentially learner-centered. With the combination of inductive-deductive instruction, this will encourage analytic learning and students' cognitive skills will be exploited.
2. It makes learning memorable since learners are actively involved in the process, so the material will be long lasting in their mind.
3. It is meaningful because it involves learners' own reasoning. With this, they can reconstruct the trigonometric formulas whenever they forget the formulas or whenever they will use it to solve problems.

From two version of Guided Discovery presented before, Hirdjan's steps of Guided Discovery is considered to be preferred to Soedjadi's steps as his steps are more flexible. This means in the Guided Discovery steps we may provide some loops in some steps. For example, in Hirdjan's steps, for some smart learners or for them who able to finish the first steps may skip the second and the next steps. Therefore, the Guided Discovery steps using in this paper is an adoption from Hirdjan's steps of Guided Discovery teaching method. As a result of the modifications are as follows:

1. Giving Problems
   The teacher gives a problem, and learners seek resolution of the problem. The given problem should contain clues to the direction and the objectives about what they have to do. Such as they find the solution by themselves from the given problem.
2. Development of Data
   In this phase, students are required to find/pointing to the possibility of other data as a continuation of the data that is already known. Students who are smart enough will finish the problem without guidance. Otherwise, they will get a guidance in the form of developed questions from the simplest way.
3. Data Preparation
   In this phase, teacher guides the students by giving them a more specific ways to find the formula using the data in step 1 and step 2. This way is in form of the steps to find the formula, but not in a general way.
4. Extra Data
   Teacher gives students extra data that will direct them to the targeted formula. It is expected that with this guidance, students can determine the formula.
5. Verification
   In this step, the students are required to verify the formula they have found by themselves. If the verification is correct, so they can continue to the next step. Otherwise, they need to recheck their work in the previous step, or they can consult with the teacher of their friends who already finish their work correctly.
6. Application Exercises
   Teacher gives the students some problems, and it is expected that they do the problems use the formulas they found.

The followings are the sample of using the modification steps in finding the formula of sin $(\alpha \pm \beta)$:

1. Giving Problems
   In this step, students are given a question whether the students are able to determine the value of sin $(\alpha + \beta)$ and sin $(\alpha - \beta)$ by providing a reason or an explanation. If they sure with their answer, they may continue to the step of Verification with a condition if they have a problem, they have to back to the second activity. But if they do not find the problem, they may continue to the last step.
2. Development of Data
   Students get a guidance in the form of new data by letting α and β in the form of numbers such as "let $\alpha = 45°$ and $\beta = 30°$, is it true if sin $(\alpha + \beta) = \sin 75°$? And is it true if sin $(\alpha + \beta) = \sin 15°$?". If the students are able to answer those question, so they may continue to the verification phase. Otherwise, they have to continue to the third steps.
3. Data Preparation
   The sample of this step can be seen in the following illustration:

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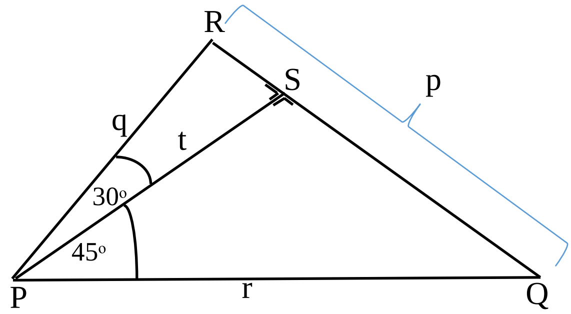


Use the trigonometric formula to find the area of triangle to determine the area of ΔPRS, ΔPQS, dan ΔPQR.

Area of ΔPRS = ……………………. (i)

Area of ΔPQS = ……………………. (ii)

Area of ΔPQR = ……………………. (iii)

From the figure above, you can determine:

In ΔPRS, cos 30º = $\frac{t}{q}$, t = ...(iv)

In ΔPQS, cos 45º = $\frac{t}{r}$, t = ...(v)

Substitute equation (v) to equation (i), and substitute equation (iv) to equation (ii):

Area of ΔPRS = ……………………. (vi)

Area of ΔPQS = ……………………. (vii)

Use the equation of (iii), (vi), and (vii) to determine the formula of sin (a + b) and sin (a - b) with given:

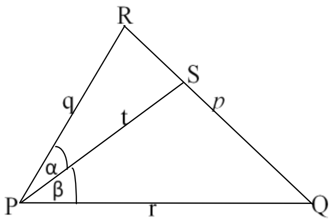
Area of ΔPQR = area of ΔPQS + area of ΔPRS
.... = ...
sin 75º = sin (45º + 30º) = ...

With the same way, you can determine the value of:
sin 15º = sin (45º - 30º) = sin (45º + (-30º) = ...

Can you determine the value of sin (a + b) and sin (a – b)? If yes, go to step 5. If not, continue to the next step.

4. Extra Data
The sample of this step can be seen in the following illustration:

Let a = α and b = β, then observe the following figure:



Use the trigonometric formula for area of triangle and determine the area of ΔPRS, ΔPQS, and ΔPQR.

Area of ΔPRS = ……………………. (i)

Area of ΔPQS = ……………………. (ii)

Area of ΔPQR = ……………………. (iii)

From the figure above, you can also determine:

In ΔPRS, cos α = $\frac{t}{q}$, t = ...(iv)

In ΔPQS, cos β = $\frac{t}{r}$, t = ...(v)

Substitute the equation (v) to (i), and substitute equation (iv) to (ii):

Area of ΔPRS = ……………………. (vi)

Area of ΔPQS = ……………………. (vii)

Use equation of (iii), (vi), and (vii) to determine sin (a + b) and sin (a - b) with given:

Area of ΔPQR = area of ΔPQS + area of ΔPRS

.... = ...

Sin ($\alpha + \beta$) = ...

As you already determine the formula of sin (α + β), then determine the formula of sin (α - β) using the formula of sin (α + β) that you have found by considering that $\alpha - \beta = \alpha + (-\beta)$.

sin (α – β) = sin (α + (– β))

= …………………………………………

sin (α – β) = …………………………………………

Remember:
cos (–α) = cos α
sin (–α) = –sin α

Of course you have found formula of sin (a + b) and sin (a – b). Then you may continue to the next step.

5. Verification

   Students are required to rewrite the formula of sin (a + b) and sin (a – b) they have found. Then they have to find the value of sin (a + b) and sin (a – b) if given a = 30º dan b = 30º, so they are able to prove whether the formula they have found is correct or not which is seen from its calculation. Because for sin (a + b) = sin 60º = $\frac{1}{2}\sqrt{3}$, while for sin (a – b) = sin 0º = 0. If their answer is correct, so they can continue to the sixth step, otherwise they can discuss to their friend until they get the right answer.

6. Application Exercises

   Teacher can provide them some enrichments such as find the value of sin 125º, sin 15º, etc.

CONCLUSION

Trigonometry as a branch of mathematics plays a big role in assisting people solve their problem, such as in economy, technology, architecture, music, etc. That makes experts believe that trigonometry must be taught as soon as possible especially in school, so that students can get to know the application of trigonometry earlier. Hence, in the process of learning trigonometry, the meaningfulness of this learning should be prioritized so that students' understanding can be more comprehensive. Guided Discovery teaching method is chosen in this paper as an alternative solution to support this condition since this method prioritizes students' involvement and reasoning ability during the discovery process of trigonometric formulas, thus material will be long lasting in their minds and become more meaningful. So that, the possibility of students choose rote learning will be minimized.

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ME – 28

The Effect Of CTL Approach With Talking-Chips Setting On Mathematical Communication Of Junior High School's Students

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Abstract**—** The purpose of this study was to describe the effect of contextual teaching and learning (CTL) approach with talking chips type cooperative setting on junior high school student's mathematical communication. This study was a quasi-experimental research whose population was all the 8th graders in SMP Negeri 3 Sleman that consisted of six classes. From the six classes, class VIII A and VIII B were randomly selected as the sample. Class VIII A as the experiment group dealt with CTL approach in talking chips type cooperative setting, while class VIII B as the control group dealt with conventional learning approach. The instrument used to collect the data was mathematical communication test. The results of the study using Independent Sample T-test in 5% significant level, showed that the CTL approach in cooperative setting of talking chips type has an effect on student's mathematical communication in SMP Negeri 3 Sleman. For further, it can be concluded that the CTL approach with talking chips type cooperative setting is better than the conventional learning approach in terms of developing student's mathematical communication in SMP Negeri 3 Sleman.

Keywords: *contextual teaching and learning, mathematical communication, talking chips*

I. Introduction

Mathematics is a part of the science aspects which its application widely used in various fields. In the appendix explanation of National Education Minister Regulation Number 22 in 2006 mentioned that the rapid development in the field of information and communication technology today is based on the mathematical development in the field of number theory, algebra, analysis, probability theory, and mathematical discrete. In the appendix was also mentioned that in addition to a focus on mathematics learning achievement, one of the goals of mathematics learning is that students have the ability to communicate ideas with symbols, tables, diagrams, or other media to clarify the situation or problem. This is referred as mathematical communication.

Based on Depdiknas (2003, p. 12) mathematical communication is a students' skill to express and interpret mathematical ideas orally, in writing or demonstrating what is in mathematical problem. On other hand, Principles and Standards for School Mathematics (NCTM, 2000) stated that "if the students have good mathematical communication skills, the students' mathematical ideas can be reflected, improved, discussed and developed. The communication process also helps the students to build understanding and belief of an idea" (p. 60). Based on the explanation above it can be seen that the mathematical communication is one of the important aspects that need to be developed in mathematics learning.

However, it is unfortunate that the process of mathematics teaching and learning in Indonesia still mostly oriented towards the mastery of basic skills, there is little emphasis on the application of mathematics in the context of daily life, communicating mathematically, and mathematical reasoning (Sadiq, 2007, p. 2). Based on information from the BERMUTU's program (Better Education through Reformed Management and Universal Teacher Upgrading) that issued by the Ministry of National Education also mentioned that Indonesia's ranking in the Trends in International Mathematics and Science Study (TIMSS) and the Programme for Internationale Student Assessment (PISA) is still far from the expectations. Indonesia's performance on the TIMSS 2007 was ranked 36th out of 49 countries, while based on the results of PISA in 2009, Indonesia was ranked only 61th out of 65 participants (Kemdiknas, 2011, p. 1).

The result of TIMSS and PISA that are lower is certainly due to many factors. One contributing factor as listed in the BERMUTU's program (Kemdiknas, 2011, p. 1-2), among others, is due to Indonesian students in general are less trained in solving problems with the characteristics of such matters in the TIMSS and PISA. This thing at least can be seen from the examples of learning outcomes assessment instruments designed by mathematics teachers of secondary school in Indonesia in the Development Model of Syllabus issued by BSNP in 2007. The syllabus commonly presents the learning outcomes assessment instrument which is substantially less associated with the context of the students' real life and less to facilitate students in revealing the process of thinking and arguing. Whereas the characteristics of matter TIMSS focuses on three domains, namely knowledge, application and reasoning, while focusing on PISA is literacy, that emphasize on skills and students' competencies who obtained from the school and can be used in in various situations of daily life.

Seeing these problems, we need a method of learning that allows students to be active, more freely to express their opinions, help each other, and cooperate with peers in solving problems to acquire the new knowledge. This is consistent with the statement of NCTM (2000, p. 61) that "to support classroom discourse effectively, teachers must build a community in which students will feel free to express their ideas." The conditions that favorable for the emergence of such matters is learning in a small-groups which called cooperative learning and make mathematics closer to students' daily life. One of the learning methods in accordance with those characteristics are contextual teaching and learning in cooperative setting. One of the advantages of cooperative learning are students can deepen their understanding as they discuss and exchange ideas with team members. Johnson (2011) revealed that "the cooperation can eliminate mental barriers due to limited experience and the narrow perspective. By working together to achieve a common goal, the students can also develop their mathematical communication skills because the students are required to explain their ideas, either orally or writing" (p. 164-165).

Furthermore, as it has been known that cooperative learning has many types. One type of structured cooperative learning model that supposedly can provide opportunities for students to develop mathematical communication skills is talking chips model. Lie (2008, p. 63) explains that talking chips model can be applied to all subjects included mathematics. In talking chips activities, each member of the group gets a chance to contribute and listen to other group member views and ideas.

According to (Kagan and Kagan, 2009, p. 6:11) "talking chips was developed to solve the problem of one or two students dominating a team discussion." Thus, the advantage of this technique is to overcome barriers of equal opportunities to contribute to the discussions that often happen in a group discussion. The learning activities like these can certainly have a positive impact not only on student learning outcomes but also open up opportunities for students to develop mathematical communication skills. Therefore, the researcher had collaborated the contextual learning method with talking chips type cooperative setting. This is accordance with the National Education Minister Regulation Number 22 (2006) which states that at every opportunity, the mathematics learning should begin with contextual problem. By filing a contextual problem, the learners gradually guided to master mathematical concepts." This is known as Contextual Teaching and Learning (CTL).

Berns and Erickson (2001, p. 2) define Contextual Teaching and Learning (CTL) as a learning process that aims to help students to understand the subject matter by linking the principal subject matter to its application in real-world situations and motivate students to connect knowledge with its application in their lives as family members, citizens, and workers, as well as engage in the hard work that requires learning. Then, for a deeper understanding of the concept of contextual learning, Center for Occupational Research and Development (CORD, 2012) describes CTL into five basic concepts of learning abbreviated REACT, namely: (1) Relating, forms of learning in the context of life or a real experience; (2) experiencing, learning in the context of exploration, discovery and invention; (3) applying, learn to apply the learning outcomes in a variety of real-life situations; (4) cooperating, learning by sharing information and experiences, and also communicate with other students; and (5) transferring, learning activities in the form of utilizing the knowledge and experience on new situations and contexts to gain knowledge and new learning experiences.

With the concept of CTL as described above, learning outcomes become more meaningful for students. The learning process takes place naturally in the form of students' activities work and experiences, not a transfer of knowledge from teacher to student. Contextual learning is a teaching that was developed with the aim of learning to walk more productive and meaningful. Furthermore, the observation and preliminary observation that researcher did in SMP Negeri 3 Sleman indicate that there were problems of mathematical communication skills at grade eighth students. The students mathematical communication problems demonstrated by the inability of students when asked to reveal the reasons in answering questions from the teacher. Additionally, when there was a problem that presented in a story form, the students got difficulties to create a mathematical model of the problems and also what they had written less structured. Furthermore, based on the observation obtained the information that the study of mathematics in grade eight of SMP Negeri 3 Sleman has not indicated the implementation of CTL approach in talking chips cooperative setting. The learning method that teachers did in teaching directly and question-and-answer method that both dominated by the teacher's role in presenting the material as well as the discussion of a practical exercise. It was less give opportunity for the students especially to develop their mathematical communication skills. Therefore, the researcher conducted this research on the effect of CTL approach with talking chips cooperative setting on mathematical communication skills of students in SMP Negeri 3 Sleman.

II. METHODOLOGY OF THE RESEARCH

A. Type and Design of Research

This study was a quasi-experimental research. It was used pretest-posttest with nonequivalent groups design. The researcher used two groups of participants, namely the experimental group and control group. The experimental group was given treatment in the form of CTL approach with talking chips cooperative setting and in control group used conventional approach. Furthermore, both groups were given tests of mathematical communication skills.

B. Time and Place of Research

The research conducted at SMP Negeri 3 Sleman located at Magelang street Km. 10, Ngancar, Tridadi, Sleman, Yogyakarta. The data was conducted in March-May, 2013.

C. Population and Sample of Research

The population in this research was all the students of grade eight at SMP Negeri 3 Sleman. The grade eight students consisted of six classes, they were class VIII A to VIII F which totaled 192 students. The sample in this research was determined by using cluster random sampling because the researcher could not directly select a random sample of individuals. In this research the class VIII A randomly chosen as the experimental group, whereas class VIII B as the control group.

D. Variable of Research

The variables in this research included independent variable in the form of learning approach with two levels that used CTL approach with talking chips cooperative setting and conventional learning approaches, as well as the dependent variable was the mathematical communication skills.

E. Techniques and Instrument of Data Collection

The data in this research gained directly by the researcher by providing treatment in the experimental group. The data collected by the test to measure the ability of mathematical communication. Meanwhile, the instrument used in this research was mathematical communication test in form of essay.

F. Validity and Reliability of Instruments

The proof of the validity of the instrument in this research using content validity that gained from the experts. And for estimating the reliability of the instruments used alternate-forms methods or equivalent methods because the instrument in this research consisted of two parallel types of tests (similar but not identical) namely pretest and posttest. The results of the instrument reliability coefficient was 0,58.

G. Data Analysis Technique

To determine whether there is any effect of CTL approach with talking chips cooperative setting compared and conventional approaches to mathematical communication skills used Independent Sample T-test. The hypothesis tested was:

$H_0 : \mu_1 \leq \mu_2$ (CTL approach with talking chips setting was not better than conventional approach in terms of mathematical communication skills)

$H_1 : \mu_1 > \mu_2$ (CTL approach with talking chips setting was better than conventional approach in terms of mathematical communication skills)

To perform a statistical test with independent sample T-test can be performed using the SPSS program. Criteria for the decision is to reject H_0 if the sig value< $\alpha = 0{,}05$. But before doing t test, the assumption of normality and homogeneity must be fulfilled. Normality test was done by Kolmogorov-Smirnov test while the homogeneity test can be seen from Lavene's test. Both were performed using the SPSS program. Particularly, if the assumption can not be fulfilled then the data can be analyzed using non-parametric method. Non parametric method will be used when the data has an unknown distribution, is non-normal, or has a so small sample size that the central limit theorem can not be applied to assume the distribution. Hence, this method is sometimes referred to as distribution-free method. U Mann-Whitney test is a kind of non-parametric test that can be used to see if there is difference between two groups. Thus, U Mann-Whitney test will be used by researcher when the asumption of parametric test can not be fulfilled.

III. **RESULTS AND DESCRIPTION OF RESEARCH**

A. Result of Research

Based on the research conducted, the data obtained were presented in Table 1.

Table 1. Mathematical Communication Test Result

Description	**Experiment group**		**Control group**	
	Pre-test	***Post-test***	***Pre-test***	***Post-test***
Mean	49,33	72,63	48,13	55,04
Varians	12,85	15,81	10,24	14,89
The highest score	68,75	96,88	73,44	79,69
The lowest score	18,75	35,94	34,38	17,19
Ideal maximum score	100	100	100	100
Ideal minimum score	0	0	0	0

Based on Table 1, it appears that the final condition after treatment, there was an increasing score of mathematical communication skills both in the experimental group and the control group with a range of different upgrade. In the experimental group the average score increased in 23,3 point from the initial score of 49,33 into 72,63. While the control group improved score was 6,91 that occurred from baseline 48,13 into 55,04. Furthermore the result of data analysis was presented as follow.

1. Normality Test
   The results of normality test with Kolmogorov-Smirnov test using SPSS program on pretest data for the experimental and control groups respectively obtained sig value 0,147 and 0,001. Because 0,147> 0,05, while 0,001 <0,005, it can be concluded that the experimental group of normality assumption fulfilled while in the control group unfulfilled. Besides, normality test results to the posttest data obtained sig value for the experimental and control groups respectively 0,2 and 0,082. Thus, the assumptions of normality were fulfilled for both groups.
2. Homogeneity Test
   Based on the results of Levene's test with SPSS program for data pretest obtained sig value of 0,2. Because 0,2>0,05, it can be concluded that both are homogeneous group. Furthermore, to the posttest data obtained sig value of Levene's test 0,777>0,05 so the assumption of homogeneity are also met.
3. *U Mann-Whitney* Test (non-parametric method)
   Because the pretest data normality assumption was unfulfilled then non-parametric method was used to analyze the pretest data. U Mann-Whitney test was used to see if there were any differences in mathematical communication pre-ability between the two groups. The test result used SPSS program obtained sig value 0,259>0,05. Thus, it can be concluded that there were no differences in pre-ability mathematical communication between the two groups.
4. *Independent Sample T-test*
   The results of independent sample t-test on the posttest data obtained sig value 0,000 where 0,000<0,05. This result was significance. Furthermore, the average mathematical communication test value of the experimental group that was 72,63 more than the control group 55,04. Thus, it can be concluded that the CTL approach with talking chips cooperative setting was better than the conventional approach in terms of students' mathematical communication skills.

B. Description

Based on the hypothesis test was known that students who received mathematics learning using CTL approach with talking chips setting had an average of mathematical communication ability more than students who received conventional learning approach. While it can be said that the CTL approach with talking chips setting had effect towards the junior high schools students' mathematical communication. This result is most likely due to the learning steps were carried out, especially at the talking chips part that strongly support students to develop their mathematical communication skills. It is accordance with (de Walle, 2008, p. 4-5) that discussion between students will be able to explore mathematical ideas from different view point, so that students can add their mathematics understanding. By working together to achieve a common goal, the students can develop mathematical communication skills because they are required to explain their ideas, either orally or writing. Talking chips technique that used in the discussion also makes students more responsible in group, because for each member of the group is required to have the same capacity to participate in the discussion. In accordance with Kagan (2009) the talking chips model have a function as a regulator of the communication and fluency builders because each student is responsible for participating. This is also supported by the CTL approach which has the principle of making the material closer to the students' daily life. This principle can make meaningfulness learning experience for students so they can easily understand the material content.

From the description above, the theories that have been studied by researcher was suitable with the result of research. The CTL approach with talking chips cooperative setting is better than the conventional approach in terms of students' mathematical communication skills, especially in grade eight students of SMP Negeri 3 Sleman.

IV. CONCLUSION AND SUGGESTION

A. Conclusion

Based on the results of data analysis and description, it can be concluded that there was an effect of CTL approach with talking chips cooperative setting on mathematical communication skills of grade eight students of SMP Negeri 3 Sleman. CTL approach with talking chips cooperative setting is better than conventional learning approaches in terms of students' mathematical communication skills.

B. Suggestion

In accordance with the finding and discussion, there are some suggestions that can be conveyed as follows.

1. The CTL approach with talking chips cooperative setting is proven in theory and supported by empirical research data can be selected as an alternative learning model to support students' mathematical communication skills.
2. For similar research, it can be suggested to make three groups design of research consisting of CTL with talking chips setting group, CTL only group and control group in order to know clearly what is more influence on students' mathematical communication skills.
3. For further research it can be suggested for using CTL approach that varied with the other type of cooperative learning model so the discussion groups can be more interesting and not boring. Last but not least, the mathematical communication skills have to be more emphasis on students' ability to create a mathematical model.

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ME – 29

Developing A Mathematics Instructional Model Based On Child Friendly, Innovative , Creative and Realistics (CFICR) At Junior High School

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Abstract. The aim of this study is to develop the mathematics instructional model based on CFICR (Child Friendly, Innovative, Creative and Realistics) at Junior High School. This study is a development research, conducted in the form of development model proposed by Tjeerd Plomp as in [6]. It consists of four development phases: (1) the preliminary investigation phase conducted to get information about mathematics instructional model theories, learning theories and the analysis of the mathematics in Junior High School, (2) the design phase conducted to design the instructional model based on CFICR, (3) the realization phase conducted to develop mathematics instructional model by following the design phase and (4) the revision, evaluation and test phase of the mathematics instructional model prototype being developed and was validated by an expert in learning mathematics and try out. This research was conducted at the Junior High School Muhammadiyah Program Khusus Surakarta. These result of this study shows that: (1) the learning management based on CFICR by teacher was in " very good" category with score 3,50 , (2) the prototype model had improved students' activities were in "very good" category and (3) the students' responses toward the mathematics instructional model was included in "positive" category. Besides that, it was obtained the instructional mathematics model based on CFICR with the following syntaxes: (1) explaining the learning objectives and motivating students, (2) giving the contextual problems that are familiar with students, (3) processing mathematics' abstraction (mathematics vertically), (4) formulating the solving strategies, (5) communicating the result of discussion and (6) giving the inferences of mathematics material.

Keywords: *child friendly, creative , innovative and realistic*

I. INTRODUCTION

Education is a conscious effort of man to guide humans in order to develop the personality and ability in accordance with the values that prevail in society. Education in school can not be removed from the process of learning and interaction between teachers and students. Reference [2] giving definition of learning is a permanent change in response highly potentiality which accurs as a result of reinforced practice. From this definition, it means that learning can produce behavior change relatively permanent students and teachers as doer change. Thus, learning is the assistance given by teachers in order can occur the process the acquisition of science and knowledge, mastery of skills and behaviour, as well as the formation of attitudes on students. In other words, learning is a process to help students to learn well. Thus, the teacher is a spearhead for feeding children contributed. The magnitude of the responsibility, then the Government gives awards for teachers by placing teachers as professionals who poured in to law teachers and professors in 2005. Teachers as professionals must have the four competencies that are teaching competence, professional competence, social competence and personality competence.

However, as in [10] states based on the results of a survey conducted by the Directorate General PMPTK informed that the most of the teachers have a low competence and the most of them have not been trained on the pedagogics. This condition is in line with research conducted Herry W as in [4] which informs the low ability of teachers in the assessment of learning outcomes and learning management. This means there are still many teachers that have low competence in teaching and learning. Because of that , they still dominate in teaching a class, do not involve students actively in the learning. They still adhere to pragmatism is everything, teachers consider the students as an object not as the subject. So with this condition, it resulted in a low level of activity and creativity of students in learning.

On the other hand, the results of research conducted by Slamet Hw, Nining as in [9] said that students need to have (1) the ability related to mathematics that can be used in solving mathematical problems, another lesson, or problems related to real life; (2) the ability to use mathematics as a tool of communication; and (3) the ability to use mathematics as a way of reasoning that can be used in any circumstances, such as critical thinking, logical thinking and systematic thinking. Reference [5] and [8] also conclude in their research that in learning mathematics liveliness, creativity and communication of mathematics students are urgently needed to improve the understanding of mathematical concepts. This will not be easily filled by students, if it is not supported the ability of teachers in teaching as well as learning resources . The learning resource limitations is one of the obstacles during the process of learning. In addition to these problems and supported teachers' ability in learning conditions are also very poor, it is necessary to find solutions to solve those problems.

From the above explanation , then it needs to be developed the mathematics instructional model based on Child Friendly, Innovative , Creative and Realistics. This research needs to be done in order to support the implementation of the curriculum of 2013 and also to increase students' activity and to improve the creativity of teachers in the teaching and learning of mathematics.

Child friendly learning refers to the the condition of the school/class that is a friendly place for students to learn. Friendly defined as a condition that is safe, joyful, and free. Safe refers to a condition that is free of violence and arbitrariness. Joyful is a condition of class that make students learn with pleasure. Free refers to the freedom of students to speak their opinion. According to Ricardo, Molly as in [7] said that the inclusion of mathematical activities in the museum, science center and other informal inveroments has the potential to complement formal learning in school mathematics classrooms, promote possitive attitudes to ward of the mathematics. This means the learning process does not have to occur in the classroom, but it can be done outside the classroom even outside of school. Thus, with this condition will be created in the process of learning, in which students free expression and gives an opinion, so that students will participate actively in teaching and learning. One type of approach in learning mathematics is a realistic approach. According to refrence [3] stated that learning mathematics with the realistic approach is an approach in which mathematics is seen as something human activities.

II. Material and Method

Child friendly learning refers to the the condition of the school/class that is a friendly place for students to learn. Friendly defined as a condition that is safe, joyful, and free. Safe refers to a condition that is free of violence and arbitrariness. Joyful is a condition of class that make students learn with pleasure. Free refers to the freedom of students to speak their opinion. According to reference [7] said that the inclusion of mathematical activities in the museum, science center and other informal inveroments has the potential to complement formal learning in school mathematics classrooms, promote possitive attitudes to ward of the mathematics. This means the learning process does not have to occur in the classroom, but it can be done outside the classroom even outside of school. Thus, with this condition will be created in the process of learning, in which students free expression and give an opinion, so that students will participate actively in teaching and learning.

One type of approach in learning mathematics is a realistic approach. According to reference [3] stated that learning mathematics with the realistic approach is an approach in which mathematics is seen as something human activities. The principal activities done in learning mathematics with the realistic approach are (1) using real-life contexts as a starting point for learning; (2) connecting to among strands, to other disciplines, and to meaningful problems in the real world; (3) using models as a bridge between abstract and real, that help students learn mathematics at different levels of abstractions; (4)

using student's own production or strategy as a result of their doing mathematics; and (5) interacting as an essential for learning mathematics between teacher and students, students and students. By using a realistic approach, students doing troubleshooting informally (using its own language), but after some time the familiar with the processes of solving similar, they will use more formal language and end the process students will find an algorithm.

This research includes the type of research development that the research oriented on the development of a product development process are described carefully and products obtained have been evaluated. The product of this research is a mathematics instructional model based on CFICR. The development model of learning mathematics based on CFICR is the main activity in this research. The development model used to develop this learning model refers to the model of development of public education from Tjeerd, Plomp as in [6]. It consists of four development phases: (1) the preliminary investigation phase conducted to get information about mathematics instructional model theories, learning theories and the analysis of the mathematics at Junior High School, (2) the design phase conducted to design the instructional model based on CFICR, (3) the realization phase conducted to develop mathematics instructional model by following the design phase and (4) the revision, evaluation and test phase of the mathematics instructional model prototype being developed and was validated by an expert in learning mathematics and try out.

This research was conducted at the Junior High School Muhammadiyah Program Khusus Surakarta grade VII. The source of the data for the validity of the model is an expers competent in the fields of the development of the model and the source of the data for the practicality of the model are an expert in the field of development, researchers and teachers who carry out learning . The source of the data for the effectiveness of the model are students.

The data analysis techniques used in this research to know the validity of the model are (a) doing the recapitulation statement validator and (b) determining the validity of the results of the compatibility with the criteria already defined. For knowing the practicality of the model are (a) doing the recapitulation statement validator and (b) determining the practicality with compatibility results with criteria that are already determined. And to know the effectiveness of the model at the end of the cycle will be given the question form of students' response about implementation models as well as the activity of students in learning.

III. RESULT AND DISCUSSION

The results of the development of mathematics instructional model based on **CFICR** of every phase are as follows:

a. The results of the preliminary investigation phase, i.e. the concept and theory of the curriculum of 2013, child friendly school (child-friendly), creative learning, innovative and realistic learning model and analysis of the material fractions grade VII about comparing fractions and operations of fractions.

b. The results of the design phase are : (1) design of mathematics instructional based on CFICR with the phases of the syntaxes are as follows (a) explaining the learning objectives and motivating students, (b) giving the contextual problems that are familiar with students, (c) processing mathematics' abstraction (mathematics vertically), (d) formulating the solving strategies, (e) communicating the result of discussion and (f) giving the inferences of mathematics material; (2) the design of the learning environment or social system, i.e. the situation or atmosphere and norms that apply in the model of learning that will be developed , such as the role of the teacher and the student to do activities for learning to take place, (3) the principle of reaction, that is related to how teachers in the notice and treat students in the learning process, (4) supporting model based on CFICR, i.e, materials/devices/media tools and learning that supports the implementation of the model and (5) the evaluation is to evaluate achievement of learning objectives pertaining to the mastery of the material with a learning model based on CFICR.

c. The results of the phase of realization is a model of learning mathematics based on CFICR prototype I .

d. The results of the test phase, evaluation, and revision are twofold, namely : (a) the results of the validation and (b) the results of the field cycles. The results of the validation showed that learning model based on CFICR that developed including the requirement is valid, because it meets the validity of the constructs and content. From the results of cycles conducted in field indicates that:

1) At the first cycle, as seen from the practicability of learning models showed the ability of teachers in the management of learning including categories is not good. This indicated the implementation of learning syntax CFICR not yet implemented properly, with a score of 2.75. While judging from the model effectiveness is measured from the activity and the response of students showed that 65% of students include the requirement of active in the learning process and responded positively towards the implementation of the learning model CFICR. So it can be said that the model of learning mathematics based on CFICR developed empirically is not practical and effective.
2) In the second cycle, as seen from the practicability of learning models showed the ability of teachers in the management of learning including categories less well. This indicated the implementation of 2 stages in learning syntax CFICR have not been executed and the score obtained in the learning management 3.0. So it can be said that the model of learning mathematics based on CFICR developed empirically is not yet practical. While judging from the model effectiveness is measured from the activity and the response of students showed that 75% of students include the requirement of active in the learning process and responded positively towards the implementation of the learning model based on CFICR. So it can be said that the learning model has not been effective.
3) On the third cycle , as seen from the practicability of learning models showed the ability of teachers in the management of learning including categories either. This indicated the implementation of all stages of the learning CFICR syntax was implemented by a score of 3.50. While judging from the model effectiveness is measured from the activity and response indicates that 90 % of students include the requirement of active in the learning process and responded positively towards the implementation of the learning model based on CFICR. So it can be said that the model of learning mathematics based on CFICR developed empirically is already practical and effective.

Thus, after the last cycle then it obtained a prototype of the final mathematics instructional model based on CFICR that is valid, practicality and effective. Implementation of this model will be implemented in the second year, i.e. the year 2016. From the results of those cycles indicate that the model of learning mathematics based on CFICR can increase the ability of teachers in the management of teaching and students' activities in learning as well as responded positively towards the implementation of this model.

This condition as a result of the implementation of the learning that begins at the initial phase of mathematics instructional model based on CFICR that is the teacher giving the contextual problems that are familiar with students. The teacher provides contextual problems. In this phase the teacher have to creativity and innovation in finding a contextual problem, so as to stimulate the creativity of the students. Students identify the problems individually. Based on their identification, students discuss the problems in their group in order to know the similarities and the differences of students' understanding of the problems. Afterwards, they have the same understanding regarding the problems. Students identify the problems individually. Based on their identification, students discuss the problems in their group in order to know the similarities and the differences of students' understanding of the problems. Afterwards, they should have the same understanding regarding the problems. The teacher encourages students to express their ideas. Each student in every group presents their ideas about the problems given and makes relations to other concepts or to realistic situations. Students in their group formulate the mathematics model based on their ideas. The model can be a bridge to connect the realistic problems and the abstract forms. This research in line with refernce [1] and [11] statement, that during the course of the study, an effort was continually made to encourage students to go trough the RME approach of simplifying the contextual problem by first represeting it in their own symbols and/or words and then futher solving and interpreting it from there.

IV. CONCLUSION

The conclusions obtained in this study are:

a. A theory of development which is used to develop a model of learning mathematics based on CFICR is modifying the development theory has been said by Tjeerd, Plomp as in [6] which contains the phases (1) the preliminary investigation phase (2) the design phase , (3) the realization phase and (4) the revision, evaluation and test phase.
b. The learning management based on CFICR by teacher was in " very good" category with score 3,50 ,
c. The prototype model had improved students' activities were in "very good" category and the students' responses toward the mathematics instructional model was included in "positive" category.
d. The instructional mathematics model based on CFICR with the following syntaxes: (1) explaining the learning objectives and motivating students, (2) giving the contextual problems that are familiar with students, (3) processing mathematics' abstraction (mathematics vertically), (4) formulating the solving strategies, (5) communicating the result of discussion and (6) giving the inferences of mathematics material.

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ME – 30

Role Of Scaffolding Toward Enhancing Understanding Of Low-Achieving Students (LAS) In Mathematics Learning

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Abstract— This article set out scaffolding as one of proper tools for heterogenous groups in class. It is particularly useful supporting low-achieving students (LAS). Low achievers have lack of not only minim abality understanding mathematics matery, but also lack of motivation to involve in practices. According to socio-constructivism by Vygotsky, scaffolding is needed to help students achieving zone of proximal development (ZPD). Additionally, *scaffolding* is one of the strategies used by children and novice for solving problem, finishing the tasks, or reaching a goal of learning process beyond their capability. It is northworthy for teachers developing either micro-scaffolding or macro-scaffolding for exploring potential of LAS. Scaffolding can be trigger for students having mathematics problems, especially in inclusive class. Thus, this article exhibit further review how scaffolding is crucial thing to increase LAS understanding in mathematics class.

Keywords: *scaffolding, low-achieving students (LAS), mathematics learning*

I. INTRODUCTION

The attention toward mathematics education becomes so very important in the world. This is evident from some of the developments that are so significant on the planning implementation of learning mathematics happening in the world. In fact, in a innovation study of mathematics will always progressing continuously. The challenge in the development of mathematics education itself is how to develop a meaningful mathematics learning and can provide a deep understanding of the students from each of the materials given during learning. It is inevitable that in any implementation of learning mathematics, many things that are a challenge someone as a teacher. It is happened because the ability of students differ from each other. Anyone has high math ability and others have low math ability. Given the diversity of capabilities that exist in students, then ineducation, especially in mathematics, low-achieving students (LAS),need to get more attention. In this case, poor understanding of the mathematics learning material will result in students having low achievement.

In this condition, there are things that need to be focused on that issue which is focusing on students who have low achievement. The strategy and understanding toward the characteristics of low-achieving students becomes crucial to be considered and acted in order to be able to understand the learning material of mathematics to be meaningful. The ways or strategies that can be done is by learning using strategies scaffolding. Bakker, Smit, and Wegerif (2015) revealed that the scaffolding has thepotential concept form integrated with applications in mathematics education.It indicates that learning through the scaffolding isessential in exploring the differences that exist on the mathematical conceptsthat are interrelated.

In the other side, Makar, Bakker, and Ben-Zvi (2015) revealed that the scaffolding as aassistance temporary and customized by a teacher or a student who has more knowledge to support students with low math ability to solve a mathematics problem. From the above explanation, the authors intend to provide an overview study about how the scaffolding strategies can help the students to understand learning material of mathematics.

II. LITERATURE REVIEW

A. Characteristic of Low-Achieving Students (LAS)

According to Broza and Kolikant (2015), there is no single definition of low-achieving students (LAS). Nonetheless, based on a recent meta-analysis (Baker et al. 2002), they categorized LAS based on teacher report on standarization of students' performance or informal tests. In this article, the term LAS focuses on mathematics cognitive deficiencies and on behavioral manifestationsof their failures. They are often pointed having mathematical learning difficulties or mathematical disabilities. Craik (2002) refers to this difficulty as *'fragilememory'*, a product of superficial data processing. There are empirical studies that characterise low achievers' mathematical competence and describe the specific difficulties low achievers experience in mathematics. These students often have difficulties in specific arithmetic areas such as conceptual understanding, such as the decimal place value system and problem solving (Mazzocco et al. 2008), and procedural competencies, such as counting or memorizing number facts LAS find it difficult to retrievebasicmathematics knowledgefrom their memory (Gray,PittaandTall cited by Broza and Kolikant, 2015).

Johnson and Schmidt (2006) described many students in this class lack not only accuracy with basic mathematical operations but they have a deep-rooted belief that they will never be very good at solving math problems. One of the goals for mathematics learning class is for students not only to develop their mathematical concept but also confidence in their own ability by helping them to become better problem solvers. They also lack meta-cognitive skills (Goldman1989),and are sensitive to the learning contexts. They have lack of basic of mathematics, thus find it much harder than others to solve simple and complex addition and subtraction problems. These difficulties may lead them to use less sophisticated strategies and commit more errors. Experiencing repeated failures and difficulties in keeping up with the class might in turn decrease the irmotivation and sense of internal responsibility and make them more passive learners. It might also lead themtoact impulsively,relying on the others judgment to them.

Afterward, there is a important question of how to increase the effectiveness of teaching and learning processes presents an important challenge to LAS; what type of support can be provided by the teacher to facilitate the student'construction of meaningful knowledge in mathematics class? Teaching the complex topic of mathematics to low achieving students (LAS)poses a special challenge, due to LAS' weaknesses such as memory deficiencies, inadequate use of strategies for solving mathematics tasks, deficiencies in generalization andtransfer of learned knowledge to new and unknown tasks,social problems, and mathematics anxiety (Haylock cited by Broza and Kolikant, 2015).

Despite LAS are having their difficulties, LAS can as well increase their mathematical conceptual of understanding. Karsenty, Arcavi andHadas (2007) and Chazan (2000) find the fact that LAS are able to display mathematical reasoning orally when placed in intimate and supportive learning circumtances.Peltenburg (2012) revelas that in Mathematics ICT usage, LAS show successfull performance in solving subtraction problems by using an indirect addition strategy spontaneously, rather than the conventional direct subtraction strategy. Similar to these studies, our approachhere is based on the belief that LAS are capable of meaningful learning in mathematics, and on the desire to capitalize on strengths and successes, rather than to focus solelyon weaknesses. LAS tend to contextualize mathematics and their concept of mathematics is associated with "doing"(Gray et al. 2000).

To enhance LAS performance in mathematics learning, They need teachers' supported in term scaffolding to trigger and explore LAS' thingking and behaviour effectivelly. It is a crucial thing for students because Some research suggests that a lack of mathematics competency such as in basic arithmetic operations can have a negative impact on success in math class (Gersten & Chard, 1999), it will affect to their confidence and motivation in the class.

B. Scaffolding

The concept of scaffolding is originated within Vygotsky's theory in learning approach. Cf Gibbons (Prediger & Pöhler, 2015) The main idea of scafsky's classical construct that using as tools to help students through zone of proximal development (ZPD). Wood,Bruner,and Ross (1976)Is first described *scaffolding* as "the process [which] enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts"(p. 89).Broza and Kolikant (2015) defined that there are six elements of scaffolding that involve cognitive, meta-cognitive, behavioral, emotional and motivational aspects (p.1094). In the class, scaffolding designed students' learning performances, keeping the novice to finish learning objectives. Furthermore, the facilitator designing the learning behaviour and makes decisions about which stimulating tasks to use, whether and when to interveneand support,and howmuch and what type of help is necessary(Wood, 2001;Prediger & Pöhler, 2015).

Practically, there is no specific definition to describe what the scaffolding is. Nevertheless, Van de Pol, Volman and Beishuizen (2010) identify the notion of scaffolding published over the years commonly refers to support given by teachers to students or students through interaction (Broza.,et.al 2015) catching cognitive proximal level of students. Broza.,et.al 2015 identify three elemens of scaffolding regularly appeared during teaching and learning (see figure 1); (1) The*contingency*, it is refers to responsiveteaching,orthecalibrated support (Broza.,et.al 2015) students' interaction along the class, providing learningsupport which is contingent on learners'needs when errors occur is considered effective for developinglearners'understanding (Wischgoll, Pauli, &Kurt Reusser, 2015);(2)*fading*, the circumtances which is "gradually removing teacher scaffoldsas the student gainsunderstandingand no longer require the teacher'ssupport" (Broza.,et.al 2015, p. 1094); (3) A gradual *transferof responsibility* to the student. It is needed to be accompanied in fading elements.The teacher offers a lot of support at the beginning,and successively fades out this support in order to transfer responsibility to students.

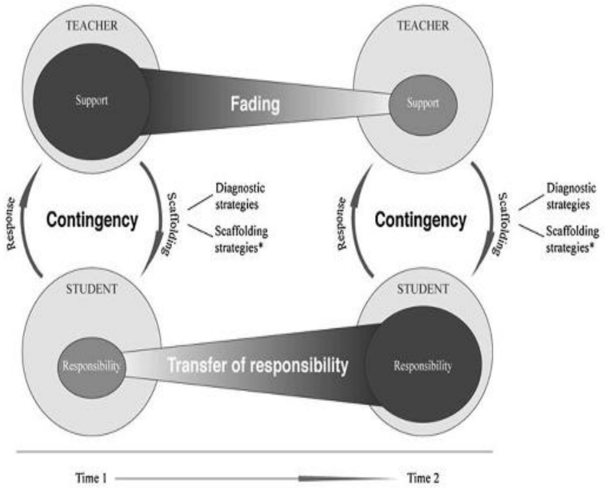

Figure 1. Model of key aspects of scaffolding
Van de Pol (S. Prediger, B. Pöhler, 2015, p. 1180)

According to Hammonds and Gibbon (Plister, et al. 2015), scaffolding can be divided as two notion macro-scaffolding and micro-scaffolding, those distingushed at which those are implemented.Macro-scaffolding has more massive area than micro-scaffolding. Gibbons (2002) and Smit (2013) cited by (Prediger & Pöhler, 2015), Macro-scaffolding as an empirical reconstruction which consists of students' prior experience, the learning goals for sequencing intermediate learning goals and support means, and instructional tasks along the intended learning trajectory. So that, macro-scaffolding includes teachers' preparation of planning, goal setting, classroom organisation, and the selection and sequencing of tasks, and contingent interaction in response to the teaching and learning opportunities.

Meanwhile, Micro-scaffolding is an important *local* phenomenon on a micro-scale of teacher-student-interactions (Prediger and Pöhler, 2015). It is fuzzy specific learning trajectory which is students' responsiveness to construct their concepts themselves, the idea supporting students to move forward in zone of proximal development (ZPD). Prediger & Pöhler (2015) highlight micro-scaffolding includes in macro-scaffolding, the role of micro-scaffolding in the interplay of conceptual and lexical learning.

According to Plister, et al (2015, p. 1080), The best scaffolding usage for students should offer activity consists of (1) *Feeding back*: Inside of scaffoding teachers should be providing information regarding the student's performance; (2) *Giving hints*: providing clues or suggestions will guided them to find the concepts. (3) *Instruction*: The scaffolding demonstrate what to do or how something must be done and why; (4) *Explaining*: providing more detailed information or clarification; (5) *Modelling*: offering behaviour for imitation and (6) *Questioning*: questions that require an active linguistic and cognitive answer. The study reported in this article empirically investigates how micro- and macro-scaffolding *depend on each other* i.e scaffolding implementation depends on the teacher itself.

C. Scaffodling for Low-achieving students (LAS)

Plister, et al (2015, p. 1081) categorizes that they are called "facets", which is aspects of scaffolding to create high quality mathematics learning for low-students. In addition, those facets are used to see how success implementation of scaffolding in inclusive class. They consits of the five following facets are listed and described.

(1)*Cognitive activation*: Krammer (Plister, et al, 2015, p. 1081) argue that cognitive activation is crucial aspect to construct students' conceptual understanding, others, it provides students' (meta) cognitive activation as well. Furthermore, cognitive activation also includes fading and transfer responsibility. To build cognitive activation in learning, students are guided to active participate in whole activity. The more active participation of students in the class, the more the responsibility during their performance will be gotten to them. Then, the last and essential part in this facet is the teachers' should invite students together to do summarize of what has been done or said during the activity (Williamsand Baxter1996),and theemphasis ison asking questions,rather than givingdirections (Lepper, Drake& Johnson.1997);

(2) *Stimulating discourse*: One of the way to achive cognitive activation is discourse orientation for learning, it is about interaction among teachers and students and between students one another (Krammer 2009). They have a time to communicate mathematical concept during the lesson. Williams and Baxter (Plister, et al, 2015) present scaffolding as a coreelement of discourse-orientated learning "…to describe actions taken by a teacher that support the creation of mathematicalknowledgethrough discourse among students"(p.1081). In addition, cooperative learning model can be choosen as the way to build discourse-oriented learning.

(3) *Handling errors productively*: A teacher should have a way to tackle students' errors and misconseption effectively. In the early, most of learning process utilize discourse usage, we often find students getting a misconception and an error. Based on a study by Lepper et al. (1997), the best tutors have the proper way to respond students' errors differently than other colleagues.Teachers are guided able to appear students' awareness about their errors and misconception by posing leading questions or offering hints to prompt students to identify and correct the errors by themselves (Plister, et al, 2015, p. 1081).

(4)Target orientation: In the beginning, teachers has to provides approriate tasks and mathematics problem which is used as guide for students' performance. According to Williamsand Baxter, It consists of utilize compatible questions, instructions, and explanations to draw students' attention that use to construct mathematical concept by themselves.selected instructional examples,
and thus to key concepts or "mathematical ideas" (Plister, et al, 2015).

(5)Using Manipulatives: In mathematics instruction, how to construct mathematics conceptual understanding needs contextual problem, thus theway problems presented is especially important. Teachers should make consideration how to present a problem to the students, includes finding

compatible way to each problems being given examples in term of manipulatives andrepresentations (Lepperetal.1997).Every students in mathematics most likely easy to understanding the matery presented with active representation and contextual problem, particularly for LAS (cf. Sect.Plister, et al, 2015).

The "facets" above can be consideration for the teachers that design techniques of scaffoding to enhance LAS in mathematics learning. Although, the idea of scaffolding was originally developed relying on the teacher itself, for the use in one-to-one tutorial situations by the teachers; however, it is now also able to be applied to classroom situations (Smit et al. 2013).

III. Conclusion and Discussion

In mathematics class, the LAS have a lack of mathematics conceptual understanding and motivation. They show massive anxiety of mathematics based on their failure experience in mathematics class. Pfister et al studies about scaffolding usage (2015) found that scaffolding are usefull tools to increase LAS performance in the class. However, it needs professional preparation before scaffolding used. The five facets which hipothesized are able to enhance LAS performance- means are inluded all of facets, are not as easy as applied during the lesson. Teachers, even training teachers (i.e teachers have got the scaffolding training using five facets), going to find obstacle to provide it to LAS correctly.

Nevertheles, it is important to understand how to encourage classroom teachers to use scaffolding and how to train them to use the various techniques in scaffolding. Lepper et al. (1997) discuss some types of training (i.e.peer-tutoring programs and computer tutors). Because the role of scaffolding toward enhancing understanding of low-achieving students (LAS) in mathematics learning. Thus, On the basis of Lipowsky's (2004) results, we recapitulate that pre-service and in-service (i.e class teachers and special education teachers) training in scaffolding techniques would be an effective option.

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ME – 31

Developing Students' Mathematical Reasoning Through Learning Mathematics with Analogical Reasoning

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Mathematics is not only about using numbers to fulfill the formulas or performing computations, but also a way of thinking. Based on NCTM, there are five standards in learning mathematics. Those are problem solving, reasoning and proof, communication, connection and representation. Mathematical reasoning is one of the ability that students must have after learning mathematics. Mathematical reasoning cannot be separated from learning mathematics. Mathematical reasoning have an important role in the proccess of understanding and applying mathematics. At the same time, mathematical reasoning also developed while we are learning mathematics. We often use deductive reasoning when we learn mathematics in school. Whereas, we also can use another kind of reasoning, inductive reasoning, to learn mathematics. One of components mentioned in inductive reasoning is analogical reasoning. Analogical reasoning is a process of thinking to obtain a conclusion or new knowledge by comparing analogical objects or their prior knowledge about something. Based on some research, inductive reasoning, especially analogical reasoning, can be used to develop students' ability in mathematical reasoning. As a teacher, we can desain a learning program which can fostering student's analogical reasoning ability. Because of the goals of learning mathematics is not only about matematics as the product of thinking, but also the process of learning and thinking, it is important for us to prepare and planned a good learning program. Focus on analogical reasoning, this paper is aimed to describe how mathematical reasoning can be developed through fostering student's analogical reasoning ability and how we can bring it in our mathematics learning program.

Keywords: *analogical reasoning, learning mathematics by analogical reasoning, mathematical reasoning*

I. INTRODUCTION

Mathematics is one of lessons thaught from elementary until secondary school. The aim of learning mathematics is to provide logical thinking, critical thinking, and creative abilty. Mathematics is not only about using numbers to fulfill the formulas and performing computations, but also a way of thinking. Based on NCTM[1], there are five standards in learning mathematics. Those are problem solving, reasoning and proof, communication, connection and representation. Reffered to this standards, mathematical reasoning is important things in learning mathematics. Reasoning is the proccess of thinking. Moreover, mathematical reasoning and mathematics are two things that cannot be separated. Mathematical reasoning is a fundamental ability which have an important role in the proccess of understanding and applying mathematics. At the same time, mathematical reasoning is also developed while we are learning mathematics.

Learning mathematics involve two aspects of reasoning. They are deductive and inductive reasoning. According to Fathima[2], inductive reasoning is generalization of the principles or conclusion of specific facts. One type of inductive reasoning is analogical reasoning. Several studies found a close relationship between student's analogical reasoning ability and student's mathematical reasoning ability. Alexander and Buehl[3] found evidence of relationship between them. Moreover, Goswami[4] stated that "experience in solving analogical problems and habit of thinking about the relationship between things that have similar properties can enhance one's mathematical ability". Alexander, White and Daugherty[4] suggested that the process of reasoning in mathematics has close correspondence with analogical reasoning process. They found that there is a strong relationship between analogical reasoning ability of someone with their mathematical reasoning ability. Viewed from that several studies, there is a close relationship between analogical reasoning ability with mathematical reasoning abilities. We can conclude that the role of analogical reasoning in the proccess of learning mathematics is very important because problems which involving analogical reasoning can be used to improve students mathematical reasoning abilities. Teachers can use learning process in the classroom to facilitate the development of student's mathematical reasoning ability throught analogical reasoning. This is accordance with the opinion of Mofidi[5] that one of the effective methods can be used by teachers to teach mathematics concepts is to use issues involving analogical reasoning. This paper will discuss how mathematical reasoning can be developed through fostering student's analogical reasoning ability and how we can bring it in our mathematics learning program.

II. EXPLANATION

A. Mathematical Reasoning

Mathematical reasoning is one of the student's ability that must be developed in learning mathematics. Steen[6] defined mathematical reasoning as "reasoning about and with the objects of mathematics". On the other hand, Russel[6] defined "mathematics reasoning is essentially about the development, justification and use of mathematical generalization". Based on NCTM[7], "Reasoning in mathematics is often understood to encompass formal reasoning, or proof, in which conclusions are logically deduced from assumptions and definitions. However, mathematical reasoning can take many forms, ranging from informal explanation and justification to formal deduction, as well as inductive observations". According to that explanation, we can conclude that mathematical reasoning is the proccess of thinking about mathematics which can take many forms, they are justification and use of mathematical generalization, make conclusion from assumptions and definitions.

Mathematical reasoning have some component. According to NCTM[1], Instructional programs from prekindergarten through grade 12 should enable all students to

1. recognize reasoning and proof as fundamental aspects of mathematics;
2. make and investigate mathematical conjectures;
3. develop and evaluate mathematical arguments and proofs;
4. select and use various types of reasoning and methods of proof.

Ball and Bass[6] state that "there are two key practices involved in mathematical reasoning – justifying and generalizing – and other mathematical practices such as symbolizing, representing, and communicating, are key in supporting these". According to English[8], nowadays, mathematical reasoning is viewed as gathering evidence, analyzing data, making conjectures, constructing arguments, drawing and validating logical conclusion, and proving assertions. Moreover, English[8] stated that "the ability to see connections and relationships among mathematical ideas and to apply this understanding to the solution of new problems is a basic component of mathematical reasoning". According to that explanation, we can conclude that the components of mathematical reasoning are

1. make conjectures
2. develop and evaluate mathematical arguments and proofs

3. generalizing
4. draw conclusions from evidence

B. Analogical Reasoning

Fathima[2] described reasoning as a thinking process, including the ability to interpret various forms and concept formation. So we can conclude that the reasoning is a process of thinking that organizes knowledge to make a new form, concept or a conclusion. There are several kinds of reasoning, one of which is inductive reasoning. Inductive reasoning is a process of generalizing the principle or a conclusion based on the specific facts that exist[2]. One kind of inductive reasoning is analogical reasoning.

Spiers[9] defined analogy as a set of problems which contains the initial problem and the target problem, where each problem has a relevant knowledge or information that can be mapped from the initial problem to the target problem. According Keraf[10], the analogy is comparing two things that have a lot in common. Gentner, Holyoak & Kokinov[8] defined analogical reasoning as one of reasoning ability by using the relationship of a pattern, include the ability to find patterns, identify repeat pattern with variations of each element, concluded from the patterns and communicate their conclusions as the goal of the proccess. Basically, analogical reasoning is the part of cognitive abilities and closely linked with someone's representation ability.

According to those opinions, we can conclude that the analogy is compare a few things based on the similarity or difference. Analogical reasoning is a process of thinking that aims to get a conclusion or new knowledge by using analogy or comparison between analogical objects with the prior knowledge about something. There are two types of the problem which use analogical reasoning.

1. Classical Analogy

Classical analogy, a type of analogical reasoning, involving some similarities in the nature of things, at least from the 4 things that will be compared. These linkages between the A and B terms and between the C and D terms[11]. The relationship in classical analogy is usually denoted by A: B :: C: D, which means the relationship owned A and B is similar to the relationship that is owned by C and D. There are two types of relation between terms in classical analogy, there are "lower order relation" and "higher order relation".

English[8] provides an example of the "higher order relation" in classical analogy is in branches: tree :: hand: human. The relation can be found between the branches of trees is similar with human hands**,** which branches are parts of a plant, as well as a hand which is part of the human body. The examples of the "lower order relation" in classical analogy is in goats: lung :: fish: gills. The relation can be found between goat and lungs is similar with fish with gills, the goats have lungs that function as a respirator, so do the fish, have gills that serves as a breathing apparatus.

According to English[8], there are three phases which always passes in classical analogy,

a. encoding phase. There is a process of identifying each object analogy to assess the properties or characteristics of each given object analogy. In this phase, the characteristics of each object analogy would be identified and the possible relationships between objects analogy;
b. infering phase. There is the process of comparing a pair of things that become the factor of analogy to determine the relationship between each object analogy. In this phase, we identified the possible relationship of each pair of given object analogy. In this phase, it is possible to appear more than one relationship between object pairs analogy can be identified;
c. applying phase. There is the process of generalizing or selection of the most appropriate relationship to complete an analogical process. In this phase, some relationships obtained in infering phase will be choose one of the most appropriate as a relationship. It will be used to determine the object analogy to complete the process of analogical reasoning.

Lunzer[8] have done a research which related with mathematical reasoning. In his research, Lunzer represents the classical analogy into a mathematics problem that includes three pairs of given objects analogy and an object analogy to look for a partner based on the relationship analogy indicated by three pairs of objects analogy that has been given.

Example question adapted from the classical analogy questions used in Lunzer research is:

18:12; 27:18; ?: 6; 24:16

What number is the most appropriate to fill the question mark?

In this case, we can refers to three phase in classical analogy by English[8] and identified how the reasoner thinking when solving problems, among others:

a. Encoding phase.

   In this phase, reasoner thinking about the characteristics of each number of the object of analogies and possible relationship.

   Suppose that when attention to numbers 18, 27 and 24. reasoner may identify some linkage between numbers, such as 18 and 27 are both multiples of 9 consecutive numbers, 18, 27 and 24 numbers are divisible by 3 or may arise identifying the nature of the other. Likewise, when attention to numbers 12, 18, 6 and 16. It is possible to identify some linkage reasoner numbers, such equally an even number, numbers 12, 18 and 6 is the number that is divisible by 3 or might appear identifying other properties.

b. Infering phase.

   In this phase, reasoner began comparing each other factors that have been identified in the encoding process.

   For example, the relationship 18:12 and 27:18. Reasoner possibly find the difference between the two pairs of these numbers, which is the difference between 18 and 12 is 6 and the difference between 27 and 18 is 9, so it is possible reasoner concluded that the relationship of the two pairs of these numbers are multiples of three consecutive numbers.

   Other relationships may arise between the 18:12, 27:18 and 24:16. One of them saying the numbers are added to the product terms 3 and 2, ie 6x3: 6x2, 9x3: 9x2, 8x3: 8x2, so it is possible reasoner concluded the pair's relationship of these numbers are the numbers that are on the left and the number that appears to the right has a fixed value ratio, which is 3: 2.

   In addition to the two relationships above, it is possible reasoner find other relationships between numbers.

c. Applying phase

   In this phase, reasoner seek the most appropriate relationship with the numbers of analogical objectwith several possible relationships that have been found in the process infering.

   For example, for the first relation, we can substract the number in each pair of the number to find the difference. In this connection, it is possible reasoner think that the right number to fill the question mark is 18, obtained from the sum of 6 and 12 as a difference in the next number. But in the next pair of the numbers, the difference between 24 and 16 are 8, not 15. So it can’t be concluded that the first possible relationship of the number can not be used to complete the analogical reasoning problem.

   For the next possible relationship, that each pair of numbers has a consistent comparisons, which is 3: 2. If the object of the right is 6 that can be expressed in the form of multiplication by 2 is 3x2, number 9 is obtained by multiplying 3 by 3 as numbers can be used to fill the object analogy to the left. Since the three pairs of these numbers qualify the relationship, then the relationship is the right relationship in analogical reasoning problem. So, the answer of the analogical reasoning problem is 9.

2. Problem analogies

Problem analogies is used to determine an analogical reasoning ability in problem solving. This type of analogy depends on the solved problem to solve new problems that become a target problem[11].

Problem analogies is presented in the form of word problems. To solve the problems of the target, we must know how the first problem, initial problem, has been solved. The steps to solved the initial problems then be applied to the next problem, the target problem[8].

The example of problem analogy that has been written by the English[8] is: “Sarah has 52 books on her self. Sue has 4 times as many as Sarah. How many books has Sue? If Mary has72 books and it 3 times as many as Peter has, how many books has Peter?”. To solve this problem, the number of Peter books resolved by the number of Sue books. Having obtained the completion of the initial problem, with the same procedures, concerns about the number of books Peter can be completed.

According to Clement[12], there are four phases which always passes in problem analogies.

a. generating the analogy, is the process of representing the conditions and possibilities of compatibility between the initial problems with the problems of the target. Reasoner identified the suitability of the things that are given as initial conditions in the initial problem and the target problem;
b. evaluating the analogy relations, is a process to re-examine, with the detail, the suitability of analogical relation between the initial problem with the target problem and determine appropriate analogical relation between the two object of analogy. In this phase, reasoner doing more detailed analysis of the relation or suitability of the problems which has been found in the stage of generating the analogy to identified the coresponding problem in the initial and target problems;
c. understanding the analogy case, is the process of testing and analyzing each component in the initial problem to understand the target problem. In this phase, reasoner analyzed the method used to solve the initial problem and the suitabilityof the initial problem with the target problem to determine the right method which is used to solve the target problem;
d. transferring findings, is the process of transfering the suitable conclusion or method which is used to solve the initial problem to the target problem. In this phase, the target problem solving by the method which is obtained in the understanding the analogy case phase.

C. Learning Mathematics

The ability of each student to learn actively is determine how the student obtain the purpose of learning. Hewitt[13] stated that "learning is an active process of constructing knowledge." This definition implies that learning is a process that is done by the students in constructing their own knowledge. Joice, Weil, and Calhoun[14] stated that "Learning is the construction of knowledge. In the process of learning, the mind stores information, organizes it, and revises previous conceptions. Learning is not just a process of taking in new information, ideas and skills, but the new material is reconstructed by the mind ". Learning is an activity to construct knowledge. Learning is consists of saving information activities, organize and refine their prior knowledge. Learning is not only a process of receiving information, ideas or new abilities, but also how the new knowledge constructed. Based on the description above, we can said that learning is an activity in which students actively build their own knowledge to achieve a competence, skill and a certain attitude.

Learning process occurs in students mind and the results of the learning process are the performance or product which is produced by the students. Nitko & Brookhart[15] stated that "instruction is the process you use to provide students with the conditions that help them Achieve the learning targets". From these opinions, we can said that learning is a process used to help students achieve their learning targets. Dick, Carey, and Carey[16] stated that "instruction is that it is a systematic process in the which every component (i.e., teacher, learners, materials, and learning evironment) is crucial to successfull learning". Learning is an activity that involves teachers, students, learning materials and learning environment to achieve the purpose of learning. Based on of those explanation, we can concluded that learning is a process that involves students, teachers and teaching materials. It is aimed to construct students knowledge by theirselves to achieve the purpose of learning. Suherman[17] defined the learning process as an educational

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process within the scope of the school. Mathematics as one of the subjects taught in school, the curriculum of Elementary and Secondary Education, is a school mathematics[17]. School mathematics consists of the parts of mathematics which is chosen to develop abilities and personality of students. Based on principles and standards for school mathematic proposed by the NCTM[1], the study of mathematics should be able to equip the students in achieving the five standards process namely problem solving, reasoning and proof, communication, connection, and representation. Based on these standards, learning mathematics is not just activity to memorize formulas or perform calculations.

III. Discussion

A. Relationship between mathematical reasoning and analogical reasoning

It has been explain before that the components of mathematical reasoning are make conjectures, develop and evaluate mathematical argument, generalization, and draw conclusion from evidence. Now we will discuss about how mathematical reasoning can be developed through fostering student's analogical reasoning ability.

One of the type of analogical reasoning is classical analogy. As stated before, there are three steps of classical analogy. When students do classical analogy about mathematics, they must use those three steps. In encoding and infering steps, they may see some relation that match the analogical object. Of course in this case these relation is about mathematics. Then, they must make conjencture which relation that really match the pair of analogical objects. Afterwards, they must evaluate their arguments why that relationship is correct. Then, they must draw conclusion to decide what relationship the most correct. So, when students do classical analogy about mathematics, they use their mathematical reasoning. It means while students do classical analogy about mathematics, they use and develop their mathematical reasoning.

The other type of analogical reasoning is problem analogies. There are four steps in problem analogies. It means when students do problem analogies about mathematics, they must do those four steps. When they do generating the analogy step, they must think all of the possibilities of compatibility between the initial problems with the problems of the target. In this step, they must make conjecture about what relationship that match. Then, as they do evaluating the analogy relation step and understanding the analogy case step, they must evaluate their conjecture that have made before. Afterwards, they do transferring finding steps. In this step, they must make conclusion from the evidence that have been gahered. From those explanation, it means when students do the problem with analogical reasoning about mathematics, the also use their mathematical reasoning. So, using analogical reasoning when learning mathematics will help students develop their mathematical reasoning

B. Learning mathematics using analogical reasoning

Based on theoretical studies, it was concluded that the analogical reasoning is a thought process that aims to get a conclusion or new knowledge by way of analogy or comparison between objects with the knowledge that has been there before. In mathematics, we can use the analogical reasoning in the learning process. Not only in the process of transfer of knowledge, but also use to reinforce the concept that has been given to the students. Here's an example of instructional design of learning mathematics using an analogical reasoning.

1. Preliminary Activity

   In preliminary activity, we can use the analogy reasoning in apperception phase. In this activity, the teacher can show the relationship of the material prerequisites or their prior knowledge to the material they will be learning, then asking them to give a similar example. In this case, we use the principle of analogy reasoning is about two things that have similar properties. Students are asked to give an example of a problem that is almost the same or may be similar to that given by the teacher.

2. Core activities

In core activity, teachers can use some types of problems that involve reasoning analogy in the process of transferring knowledge. The teacher can providing stimulus material to students using the analogy of classical or analogy problems. For example in the study of geometry in grade VIII, we can take advantage of a classical analogy to direct students find the concept of giving name of prism. Teacher can give some pair of the picture of prism with different base side and their name. And then, teacher give the picture of prism with n-side and ask them to give the name of that prism. Moreover we can take advantage of the problems of analogy, to lead students to find a concept to define the terms of a general formula for the surface area of prism-n.

It just an example for using two kinds of analogical reasoning. Moreover, we can give the problem and the solution, more times, and then give a problem to the student which isi analogous with example problem and then ask them to solve the problem based on the example. It use the principal of analogy, that compare two things that have the similarity.

3. Closing activity

In the closing activity, we can use the analogy of reasoning in the stabilization phase of the material they have learned. We can provide exercises using the two types of analogical reasoning above to reinforce the concepts they have learned.

IV. CONCLUSION

Analogical reasoning and mathematical reasoning has strong relationship. Mathematical reasoning can be developed through fostering student’s analogical reasoning ability in learning process. Analogical reasoning can be used in preliminary activity, core activity, and closing activity in learning mathematics. When students do classical analogies and problem analogies in learning mathematics, students use the components of mathematical reasoning. It means by using analogical reasoning, students mathematical reasoning can be developed.

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Undergraduate Student's High Order Mathematical Thinking Abilities Through Lesson Study Activities

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Abstract—The purpose of this research is to develop lesson study learning activities aiming to improve undergraduate students' high order mathematical thinking abilities. This paper is intended to describe the learning activity-based on lesson study to improve student mathematical communication and problem solving ability. This research involved 36 students who take analytic geometry courses. This research is done by using the steps in activity-based on lesson study. Implementation of the research took place in four cycles. Each cycle consisting of activities plan, do and see. The instrument used are the observation sheet, instructional videotape, student worksheets, test for mathematical problem solving and communication ability. Analysis on data revealed that the undergraduate students' high order thinking ability especially in mathematical problem solving and mathematical communication increased significantly. By analysis, undergraduate students' mathematical problem solving, and mathematical communication ability was categorized good. Students already have the ability to analyze a given problem and make a plan how to solve the problem and then solve it as planned. Completion obtained through reflected in the classroom discussions.

Keywords: *mathematical communication, mathematical problem solving, lesson study*

I. INTRODUCTION

Issues concerning about mathematical thinking are one of the fundamental goals of mathematics curricula and instruction. One of the ability that need to be mastered mathematics student teachers is mathematical problem solving ability. According to NCTM [1]standard for mathematical problem solving ability mathematical learning programs should enable students to: build new mathematical knowledge through problem solving; solve problems that arise in mathematics and in other contexts; implement and customize a variety of appropriate strategies to solve problems; and monitor and reflect on the process of problem solving in mathematics. Solving ability is an integral part of learning mathematics. As noted Ruseffendi[2] that the problem-solving ability in mathematics is essential, not only for students who would later explore or learn math, but also for students who will apply it in other areas of study and in everyday life.

Besides having the mathematical problem-solving ability, ~~of~~ students should also be able to communicate mathematical ideas student had verbally and in writing, students must be able to interpret and evaluate the problems that arise so as to obtain the appropriate trouble shooting. Capabilities that support mathematical problem solving ability is called mathematical communication skills. So in order to become a perfect problem solver, student must have good mathematical communication

Students will have good ability to problem-solving and mathematical communication if both of these capabilities are continuously trained on learning activities in the classroom. The quality of learning that can facilitate to develop students' ability and can be done with the planning, implementation and evaluation of learning activities in a sustainable manner. One way of improving the quality of continuous learning is by conducting lesson study. Lesson study is an approach to improve the quality of learning that applies the concept of learning communities from each other to increase knowledge. Events

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Calendar[3]defines the lesson study as a method of analysis of the case in practice learning, which aims to help the professional development of teachers and lecturers as well as an opportunity for teachers to learn from each other through the learning activities in the classroom. In lesson study activities, teachers can use a variety of learning models that correspond to the learning material or conditions that will be done. One of these is the model of learning problem-based learning.

A. Mathematical Problem Solving

Intellectual abilities are classified based on the level of complexity and is composed of the simplest mental operations to the most complex level. Problem solving is one type of intellectual skill rank higher and more complex than other types of intellectual. According to Kirkley [4] mathematical problem solving involves higher level thinking skills such as visualization, association, reasoning, manipulation, abstraction, analysis, synthesis, and generalization. The term “problem solving” refers to mathematical tasks that have the potential to provide intellectual challenges for enhancing students’ mathematical understanding and development. NCTM [1] stated that problem solving as a process that encompasses the entire process of teaching-learning provides skills about a contextual concepts.

Solving problems involving varying contexts derived from the linking problems in daily life situations posed mathematics. Students can solve some of the problems posed to them by others. However, it is easier for them to formulate their own problems based on personal experience and interest. The importance of problem solving ability, namely: (1) the ability of problem solving is a general purpose teaching of mathematics, even as the heart of mathematics, (2) solving the problem can include methods, procedures and strategies or ways used is a core process and major in mathematics curriculum, and(3) solving the basic skills in learning mathematics. Through problem solving, students will have the basic capabilities that are more meaningful in thinking, and can make strategies for the completion of further problems. Polya [5] describes in detail the four steps in solving problems, which are presented in sequence, namely: (1) understanding the problem (2) devising a plan (planned completion), (3) carrying out the plan (implement the plan), and(4) looking back(to re-examine the process and outcomes).

For the purposes of this study is a mathematical problem-solving ability is the ability to identify the elements that are known, asked, and the adequacy of the required elements; able to make/prepare mathematical models; can choose and develop coping strategies; able to explain and verify the answers obtained. To measure the ability of solving mathematical problems required several indicators. In this study, to measure the ability of students' mathematical problem solving test given in the form of questions about the material being taught. According to Turmudi [6] The indicator shows the mathematical problem-solving ability in this study are as follows.

1. Demonstrate understanding of the problem, including the ability to identify the elements that are known, asked, and the adequacy of the required elements.
2. Ability to create/construct a mathematical model, includes the ability to formulate problems of everyday situations in mathematics.
3. Select and develop coping strategies, including the ability raises various possibilities or alternative means of solving formulas or knowledge which can be used in solving the problem.
4. Able to explain and verify the answers obtained, including the ability to identify errors of calculation, the use of a formula error, check the compatibility between that have been found with what is being asked, and can explain the truth answers.

B. Mathematical Communication

Hulukati [7] said mathematical communication refers to the ability to use mathematical language to express mathematical idea and arguments precisely, concisely and logically. It helps students develop their own understanding of mathematics and sharpen their mathematical thinking. Mathematical problems solving that have been discussed previously closely related to mathematical communication. Students who already have mathematical problem solving ability are required also to be able to communicate, so that understanding can be used by others. With the students' mathematical communication skills can also take advantage of the mathematical concepts that are already understood others. By communicating mathematical ideas to others, one can improve mathematical understanding. Huggins[6]that in order to improve the mathematical conceptual understanding, students can do to express mathematical ideas to others.

Mathematics is the language of symbols in which everyone who studied mathematics required to have the ability to communicate using language symbols. Mathematical communication skills will make a person can use mathematics for its own sake as well as others, so it will increase positive attitudes towards mathematics both from within themselves and others. Sumarmo [7] suggested that mathematics as a language of symbol simple that mathematics is universal and can be understood by anyone anytime and anywhere. Each symbol has a clear meaning, and agreed to be shared by everyone. For example, the symbol '9', the operation +, - apply nationally each school level wherever that maybe understood by everyone.

Communication ability can support another mathematical abilities, such problem-solving ability. With good communication skills, students can be represented faster properly and this should be supportive for problem-solving. Hulukati[8] states that communication skills is a prerequisite for solving mathematical problems, which means that if students are not able to communicate properly interpret mathematical problems and concepts he can't resolve the problem well. In this regard, Pugalee[9] stated that in order for students to trained mathematical communication skills, the learning of students need to get used to give arguments on each answer and provide feedback on the answers given by others, so that what is learned to be more meaningful for him.

Mathematical communication can be developed in various ways, among them through group discussion. Within Saragih [10] suggests that the ability of communication becomes important when the discussion among the students performed. In the discussion, the students are expected to declare, explain, describe, listen, inquire and cooperate so as to bring the students to a deep understanding of mathematics. Therefore while students communicate their knowledge, they can lead to renegotiation between students' responses, and the role of the teacher is expected only as a filter in the learning process.

Students' mathematical communication is the ability of describing an algorithm and a unique way of solving the problem, the student's ability to construct and explain real-world phenomena serving as a graph, words/sentences, equations, tables and serving physically or ability of the students to give the all edged geometry images.

Mathematical communication are: (a) the central force for students in formulating concepts and strategies; (b) capital for student success and completion of the approach in the exploration and investigation of mathematics; (c) a place for students to communicate with their friends to obtain information, share thoughts and discoveries, brainstorm, assess and refine ideas to convince the others. Broader understanding of mathematical communication proposed by Rombergand Chair(in Sumarmo) [7], namely: (a) connecting real objects, drawings, and diagrams into mathematical ideas; (b) explain the ideas, situations and mathematical relationships orally or in writing with real objects, images, graphs and algebra; (c) declare a daily occurrence in the language or mathematical symbols; (d) listening, discussing, and writing about mathematics; (e) read with understanding a mathematical presentation of written, making conjectures, formulate arguments, formulate definitions and generalizations; (f) explain and make inquiries about the mathematics they have learned.

Baroody[11] suggests five aspects of communication, the five aspects are:

1. Representing, made are presentation means making another form of an idea or a problem, a tabular represented in the form of a diagram or better.
2. Listening, aspect of hearing is one very important aspect in the discussion. The ability to listen to the topics being discussed will affect the student's ability to give an opinion or comment.
3. Reading, the reading process is a complex one, because it related aspect to remember, understand, compare, analyze, and organize what is contained in the passage.
4. Discussion, in the discussions students can disclose and reflect his thoughts related to the material being studied. Students can also ask things that are unknown or still undecided.
5. Writing, writing is an activity performed by the conscious mind to reveal and reflect, as outlined in the media, whether paper, computers and other media.

In this study, mathematical communication skills will be measured through students' ability to express mathematical written communication skills in mathematical problem. In any mathematical problem, measuring communication skills in writing made by the indicators are: the ability to express and illustrate the mathematical ideas in the form of mathematical models that form equations, notation, pictures and graphics, or vice versa.

C. Learning Based on Lesson Study Activities

Students' mathematical thinking ability can be developed through training and habituation carried out repeatedly and continuously. In order to help students have mathematical thinking ability the teacher must be designing a learning process that potentially motivates students to be confident about their ability to solve the problem. Unfortunately the teachers lack of the idea to design learning process when they doing alone. Therefore, teacher can collaborate with another teacher to design learning process. When teachers coming together to design the learning process this activity namely lesson study. Lesson study is a potent embedded peer to peer professional learning strategy. According to Isoda, Stephens, Ohara and Miyakawa [12] lesson study is a process by which teachers of mathematics at several schools in the same community work together to research teaching materials, develop plans (lesson plans) and practice teaching lesson. In lesson study a group of teacher involved collaboratively planning, teaching, observing, and analysis learning and teaching in a research lessons. Lesson study is a scientific activity for teachers who want to develop their student ability, especially in mathematical thinking ability.

Lesson study is recognized with many features one of them is lesson study process or cycle. According to Sato [13] in Indonesia lesson study introduced as an activity consisting of plan-do-see

II. RESEARCH METHOD

This study is a qualitative descriptive study of learning done following the steps in the lesson study activities, This research was conducted in the second semester of the academic year 2013/2014, in Mathematics Program in Faculty of Teacher and Training, University of Muhammadiyah Bengkulu. The subjects were students of fourth semester who took analytic geometry course. Number of students involved is 36. Implementation research is conducted through the stages of the lesson study activities consisting of 4cycles. Each cycle has the following stages.

1.Plan

At this stage, the lecturer models to collaborate with some of the faculty observer to design learning is done by discussing determine the issues to be given to the student. Student centered learning designed with cooperative setting. Learning tool compiled and discussed to be fixed so as to minimize the existing deficiencies. The device is composed of student worksheet, observation sheet for learning activity and mathematical problem solving and communication test

2.Implementation(Do)

Activity at this stage is, lecturers models implement learning activities in accordance with the design that was created earlier. Observations carried out by a team of observers to observe the course of learning.

3.Reflection(See)

At this stage of reflection, lecturers discuss the model and the observer back to discuss the results of the observation of the observer. At this stage the model can be expressed lecturer difficulties encountered when implementing the learning activities. Lecturer observer provide findings that occur during learning activities take place. As the observers may have focused on different parts of the action, this has the advantage that the lesson is seen from several view point by a team who have the idea fresh in their minds.

Data collection in this study was done by

1. Observation

Observations conducted to collect data on learning activities, findings and students' ability in problem solving and mathematical communication. Filling in the form of a narrative observation sheet which can describe the picture of the learning process that occurs.

2.Documentation

Documentation used to obtain activity data plan, do and see through video recordings and written student work on the Student Activity Sheet.

3.Tests

Test scores are used to acquire problem solving skills and mathematical communication students after participating in learning activities.

Furthermore, the data obtained were analyzed qualitatively.

III. RESULT AND DISCUSSION

Result

Results and findings during the course of the lesson study is summarized by the indicators capabilities mathematical problem solving and communication. These indicators can be observed through the activities undertaken by the students during the learning process. Here will be presented the results of observations based on indicators of the problem solving and mathematical communication.

1.Mathematical Problem Solving Ability

Learning activities based on lesson study activities. In the learning activity models begin by reminding prerequisite the material has been learned and convey that learning activities done individually first followed by a discussion in groups and with the final class discussion.

a. Indicators Understanding the Problem

In the first open lesson learning activities begin with teacher give students an open problem related to outbound activities. The purpose of this materials to find the equation circle with a central at the point (a, b).

The problems identified are as follows:
At this stage of understanding the problem arises the opinions of students characterized as proposed by the group A: that the direction of the sun also determines the position of the hood, which means taking into account the displacement towards the north south east west if it is associated with the coordinate plane A rat nor this the direction of the positive y-axis, the south is the negative y-axis, the west is the direction of the negative x-axis and the east as the direction of the positive x-axis. So when there is a shift in the outbound playground will also affect the central of the circle. However, group B has a different opinion, students in this group said that the shift will not shift the playing field flag pole at the central so that the understanding of the game in the beginning of this group to the problem is to add distance to two times the game arena. This shows that students are trying to understand a given problem from the stand point of their own.

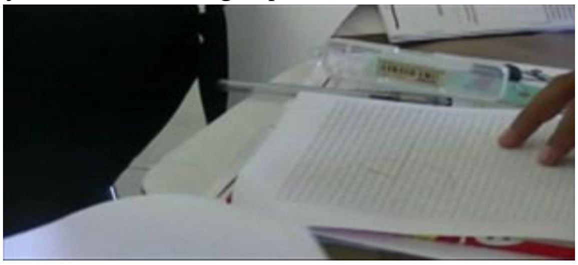
Students actively discuss in a group to understanding the topic

.b. Indicator Planning to Solve the Problem

Based on the understanding of the problem is given each planning group has different settlement. A group planning to shift the center of the circle in the direction of shift in the direction opposite to the direction of the sun so that the selected center is to the east. While group B planned completion by adding a second radius of the circle.

c. Indicators Implementing the Plan

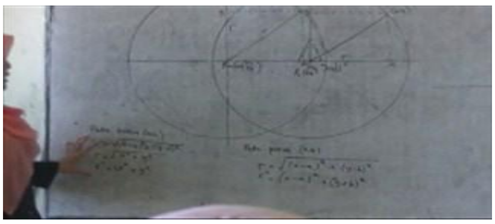
From planning made visible jobs results of each group as shown below:



Students made a plan to solve the problem

d. Indicators Check the Results of Solving Problem

At the time of the class discussion each group presented the results of his work and see if it is right or wrong. Lecturer models provide guidance through questions that dig so that students can summarize the results of solving the problem. The result of solving the problem is a circle equation that has the same radius of the circle in the center of the equation(0.0) but shifted the center of the circle. This shift though towards the right, left or up and down will still produce the same circle equation.



Students discussion their job for check the right answer

2.MathematicalCommunication Ability

Mathematical communication skills of students look when they perform well in group discussions and in-class discussion. Almost all students have dared to express his opinion as follows. Student A: That point was originally flag pole, after the sun high and hot atmosphere of the area game on the move with the same distance, the same fingers

Student B: between the first and second position of the same but the distance is summed so that his fingers womanly twelve.

Students already demonstrating that they have the ability to express mathematical idea, interpret and evaluate a problem and can be poured into a mathematical representation that corresponds to his thinking. It is a characteristic of a person who has the ability to reasonable good mathematical communication.

Observations indicate that the student already has the ability to problem-solving and mathematical communication even though there are still some students who have not been up involvement in learning.

Discussion

Students' can solve all of the problems that given by the teacher. This meant the students had high concentration on studying and learning activity more effective, thus the students could understand. In this case, if the students understand the lesson well, they will know the methods of solving the problems, then they will achieve in their study. If students have high activity in learning, their learning achievement will be absolutely higher than having poor activity while studying. Mathematical communication ability was both direct and indirect effect to mathematic problem solving by passing through students presentation. Mathematical communication ability affected the students' mathematic problem solving ability in a positive way.

IV. CONCLUSION

Learning that has been designed by faculty model and the observer was able to bring the train activity and problem-solving ability of students developing mathematical communication pretty well. From the results and discussion in this study it can be concluded that the learning models problems with cooperative setting in lesson study activities in the course of analytic geometry and space field can help the development of problem solving skills and mathematical communication students.

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ME – 33

Analysis of Statistical Reasoning Process of Senior High School Students on the Size of Central Tendency

(The Case Study For Student's Low Math Ability)

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Abstract- Reasoning is one of fundamental aspects of mathematics learning, it is as one of the necessary abilities of each student in the era of globalization that is full of challenges. The ability to reason is not only needed when students learn, yet very necessary when a person determine the decision. The aim of this article was to describe the statistical reasoning of high school students with low math skills to solve problems statistics. This research was a qualitative descriptive study. A qualitative approach is used to describe in depth how the reasoning process statistic subject to resolve issues related statistical measure of central tendency (mean, median, mode). The subjects were two students of class XI SMA Negeri 15 Makassar, with low math skills. It could be seen from the behavior of the subjects in completing written assignments are given, followed by in-depth interviews related to a given task. The research revealed that the subjects know the algorithm for calculating the average. At the stage of determining the median there was a difference perception between the two subjects, while the second mode related subjects had the same perception of the majority. At this analysis and interpretation stage, both of the subjects had not been able to interpret the statistical values obtained in accordance with the context well.

Keywords: *Statistical Reasoning, Senior High School, Statistical Problem, Low Math Ability*

I. INTRODUCTION

The functions of statistics as a science plays important role in all aspects of human life, as means to develop way of logical and scientific thinking . Statistics is used in order to collect, present, arrange, analyze and draw a conclusion mathematically. Ben-Zvi & Garvield [1] states statistical learning can be a tool to analyze the information or data, resulting from the information or the data can be taken the right decision in solving a problem.

Statistics as a part of a math lesson taught ranging from basic education to higher education require reasoning for such a study. Every day we face a variety of situations, problems or phenomena that has happened, is happening and phenomena that will occur, where most of the problems or phenomena in the form of a set of data and required thinking or reasoning for taking a decision in the face of these problems. Statistical reasoning plays an important role in dealing with situations, someone who is dealing with a set of data or events in everyday life. For example, when someone is watching television, reading newspapers or magazines, while active on the political activities or other social activities, often times the information obtained may be represented in various forms; e.g. graphs, tables, diagrams or combination of both.

At this time the statistics have been used in all areas of science, even been used by many giant companies of the world, e.g. Japan's success in applying the science of probability in designing and marketing a variety of products such as various electronic goods, cars, motorcycles and various other products. This accomplishment can be achieved due to the success of the Japanese education on the subjects of statistics given widely from upper secondary education to higher education. [2]

Related the importance of familiarization reasoning for students in the learning process of mathematics, Soedjadi [16] states: civilizing reasoning would be achieved if the effort to organize the reason that learners can run well so as to cultivate the habit of reasoning. By using the curriculum however reforming the reasoning required attention in the study of mathematics. It is becoming increasingly important in view of the future that is characterized by competition. In order to reasoning acculturation can be achieved, it is necessary that the presentation of mathematics in schools, both in the classroom and in textbooks, really directed to the structuring of reason.

In mathematics, as stated in the NCTM [14] it is expected that students will improve their ability in terms of reasoning (reasoning), problem solving, mathematical communication and in terms of using the mathematical representation. In the 2013 curriculum for all subjects are taught with the same approach that approach saintific through observe, to question, to reason, to try and form a network (here seems a shift of the students were told to the students to find out). It appears that the proficiency level on the reasoning aspects of the curriculum in 2013 is a very important thing, because if students are not developed reasoning ability, then for students of mathematics including statistical material will only be a matter that follow set procedures and emulate the examples without knowing its meaning.

The explanation above states that statistical reasoning ability is something that is sorely needed by the terms of the components of society, including students who take basic education to higher education which is the cornerstone of the nation's future in the future.

In this study the problem to be assessed is a matter of statistics. Completion of statistical problem is an important issue and needs to be studied, because it is through solving problems mainly related to the student experience in the daily life of students are expected to be skilled in identifying, selecting relevant knowledge in describing, interpreting the problem to make generalizations. However, in the study of mathematics in high school, statistics or mathematics problem solving cannot be done easily and quickly. To resolve these problems required reasoning.

Ability to solve problems related to mathematics and statistics is influenced by several factors, both internal and external factors. Internal factors include: interest, motivation, talent, intelligence and mathematical ability and gender, while external factors related facilities and infrastructure, curriculum, teachers, the media, other learning facilities.

The research result of Nurman [14] states that a student math skills affect the ability of mathematical problem solving. Students are capable of higher mathematics has high ability in solving mathematical problems, while students who have low math ability of mathematical problem solving ability are less good.

Based on the description above, the research questions that will be discussed in this article is "How does a statistical reasoning of eleventh year students who have the ability to lower the Mathematics Statistics in solving the problem?"

II. LITERATURE REVIEW

According to Ben-Zvi and Garfield [1]Statistical Reasoning as the way people reason with statistical ideas and make-sense of statistical information. This involves making interpretation based on sets of data, the representation of the data, or statistical summaries of the data. Statistical reasoning may involve; connecting one concept to another (e.g. center and spread), or it may combine the data and ideas about chance. Reasoning means understanding and being Able to explain statistical processes and being-able to fully interpret statistical results. "

Martin [5] defines the statistical reasoning as follows: "Statistical Reasoning as forming conclusions and judgments According on the Data from observation studies, experiments or sample surveys". From the definition above can be concluded that the reasoning statistically is the mental activity in connecting some of the concepts, facts, procedures in reaching conclusions that include describing, organizing, data reduction, represent the data, interpret and make sense of the ideas of statistics in the conclusion and be able to interpret the data which is obtained. Lovett { 5} claimed Statistical Reasoning involves the use of statistical ideas and tools to summarize the situation and draw assumptions and make conclutions from the data".

[8] stated statistical reasoning as a three-step process, among others:

1. Understanding (see particular problems as an issue)
2. Planning and implementation (to apply appropriate methods to solve the problem), and
3. Evaluation and interpretation (interpreting the results related to the initial problem.)

In practice, statistical reasoning involves being Able to assess how well the data are collected, describe the data, the draw Conclusions from the data, and allow for the UN- certainty that results from the use of a sample. Students, therefore, need to under- stand how sampling is influenced by the variation that is present in every process [6]

Garfield [9] states there are six reasoning goals for students: 1) reasoning about the data, 2) reasoning about representations of the data, 3) reasoning about statistical measures, 4) reasoning about uncertainty, 5) reasoning about samples, 6) reasoning about assosiation , In this research framework Jones et al [6] in assessing the statistical reasoning that high school students of class XI; describing the data; organizing and reducing the data; representing the data; and analyzing and interpreting data. There are two types of reasoning commonly incorporated into the statistical reasoning assessment instrument namely reasoning about the center and spread. Reasoning concerns about the data center analysis that involves the mean, mode and median. Meanwhile, spread involves reasoning about range, quartile, variance, and standard deviation.

Jones et al [6] suggest that in order to assess a person's ability to describe data (describing data) can be viewed on the ability of a person a) an accurate reading raw data or can show role in the form of tables, charts or graphs, b) demonstrate an understanding of convention elements graphics, c) have an understanding when given different views for the same data, d) evaluate the different views of the same data. Meanwhile, to assess a person's ability to organize and reduce the data (organizing and reducing data) are: a) Classify and sort the data, b) Recognize that there is information that may be lost in the segment data, c) Describing the data, the types of data and representation of data d) Describe the distribution data.

To represent data (representing data), [6] states that to assess a person's ability to represent data is:

a. Complementing the display of the data presented is not complete
b. Build the display of data representing different classification of the data set.

Jones et al [6] also stated that to assess a person's ability to analyze and interpret data (analyzing and interpreting data) is as follows:

a. Comparing and combining the data

b. Extrapolation and predict data.

Mooney [6] states: (1) describing the data e.g. tables, graphs, a list of which is looking for information explicitly stated in the display, acknowledge graphics conventions, and make a direct connection between the original data and display. This means that when describing data explicitly require the reading of the data presented in tables, charts or graphs representation; (2) organize and reduce the data associated with the process of organizing, categorizing, or consolidation of data in summary form; (3) represents the data associated with the data is displayed in graphical form. The process according to Groth (2003: 6) is able to make the display of data or an alternative view for a given set of data; (4) analyze and interpret data related to how to identify trends and make conclusions or predictions about the data.

NCTM [10] defines mathematical ability as "Mathematical power includes the ability to explore, conjecture, and reason logically; non-routine to solve problems; to communicate about and through mathematics; and to connect ideas within mathematics and between mathematics and other intellectual activity".

According to A.M. Blackwell [12], mathematical abilities are: "Mathematical ability indicates that Reviews These abilities can be interpreted as abilities for selective thingking in the realm of quantitative relationships (quantitative thinking) and for deductive reasoning, and as the ability to apply general principles to particular cases in the realm of numbers, symbols, and geometric forms "Meanwhile, according to G.Revesz [12] mathematical skills, namely: "Examines two basic forms of mathematical ability: Applicative (the ability to find mathematical relationships quickly intervening, without preliminary trials, and to apply the Appropriate information in analogous instances) and productive (the ability to reveal relationships that do not follow Immediately from the available information)"

A measure of central tendency is a single value that attempts to describe a set of data by identifying the central position within that set of data. As such, measures of central tendency are sometimes called measures of central location. They are also classed as summary statistics. The mean (often called the average) is most likely the measure of central tendency that you are most familiar with, but there are others, such as the median and the mode. The mean (or average) is the most popular and well known measure of central tendency. It can be used with both discrete and continuous data, although its use is most often with continuous data. The mean is equal to the sum of all the values in the data set divided by the number of values in the data set

Average is judged as measures of central tendency which comprised of mode, median, and mean by several statisticians. Nonetheless, average was interpreted in a different way based on problem context as argued by Konold & Pollastek [11], for instance fair share, data reduction, signal in noise, and typical value.

There are seven properties of average as declared by Strauss and Bichler [17]. The first property of the average is put between the extreme values and the second property is the summation of the deviations from the average is equal to zero. The third property is the average is affected by val ues except the average while the fourth property is the average is not primarily the same as one of the added values. The average could be a fraction that has no matching part in physical reality is the fifth property. The sixth property is the zero value ought to be considered when computing the average and the seventh property is the value of the average is indicative of the values that were averaged.

Furthermore, Mokros and Russell [13] found out five approaches to obtain the average that employed by the students from fourth, sixth and eighth grades including average as mode, average as algorithm, average as reasonable, average as midpoint, and average as mathematical point of balance. Those approaches were classified as two groups, i.e. approaches that do not view average as representative including average as algorithm and average as mode, as well as approaches that view average as representative including average as reasonable, average as midpoint, and average as mathematical point of balance.

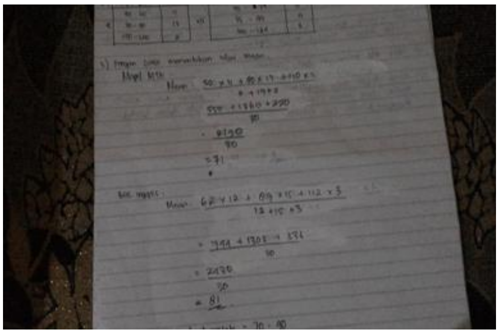
III. RESEARCH METHOD

This research applied a descriptive qualitative method, the research seeks to find meaning behind the symptoms or phenomena that occur. This study aimed to describe the statistical reasoning of eleventh grade high school students who had poor math skills. The approach used was a qualitative approach based on the grounds that this study met the characteristics of qualitative research, namely: (1) it was natural, that research was conducted according the actual circumstances in which the researcher as the main instrument, (2) the data was descriptive in the form of a series of words or image, (3) focus more on the process than the results, (4) the data processing tends to be done inductively, and (5) the main focus research is aimed at all the activities carried out individually [7]

The subjects of this research were students with low math skills. The process of collecting data in this study using a task-based interviews in which subjects were given the task of statistical reasoning (TPS), then the subject in asking reveal what he was thinking and asked to describe in detail his thinking process. Furthermore, do interviews and observations to explore the reasons, why take these conclusions and possible other solutions that could be done, including the unique things done by the subject when disclosing or submit comments. At the time of data collection, all activities performed research subjects recorded using audio and audiovisual recording devices, as well in the interview.

IV. RESULT AND DISCUSSION

Results based interview task of the two subjects on the collection of data describing the reasoning process of the subject on the size of the symptoms of the center when given the task of determining the average, median and mode were as follows: (1) At the stage of determining the average of the first subject using the formula average for grouped data in a way: first determine the subject of the largest and smallest values to determine the range, then create a table and specify the interval and determine the frequency of each interval. After that subject calculate the average value by multiplying the value of the center of each interval with a frequency followed by summing and further divided by the number of frequencies. This showed that a procedural subject can organize the data and know the algorithm for calculating the average, but when asked to explain the meaning of the average of the results obtained, the subject stated the average was mostly or at most. Here is the work of the first subject.



(The picture above was one of the student's work)

(2) At the stage of determining the Median of first subject and the second subject did not know the formula median for grouped data. But for the first single data subject can explain how to determine the median of the data even or odd numbers well, which was a way to first sort the data from the smallest to the largest data. If even then the data after the data burst, then the median was the middle of the two data divided by two, but if the data was odd, the data lays the middle was the median. Subject to the two states to determine the median is the same as determine the average. The results indicate that the two subjects into trouble and did not know the formula for a median of grouped data, but there were cognitive differences between the first and second subject of the median, where the first subject can distinguish how

to calculate the median and average. The median for the two subjects was the middle value. Here are excerpts of an interview with both of the subject.

Excerpts of an interview with the first subject:

Researcher : What is average?

Interviewee : Add and divide by the number

Researcher : What is the definition of average?

Interviewee : The most

Researcher : What is median?

Interviewee : The mid-point

Researcher : How do you determine the median?

Interviewee : If a single data in advance data is sorted from smallest to largest data

Researcher : And then?

Interviewee : If the data is an even number, the two most central data summed and then divided by two is the median, but if the data is odd, then the data that most middle after a median of data sequences.

Excerpts of an interview with the second subject:

Researcher : What is average?

Interviewee : Add and divide by the number

Researcher : What is the definition of average?

Interviewee : The most

Researcher : What is median?

Interviewee : The mid-point

Researcher : How do you determine the median?

Interviewee : Same way with an average

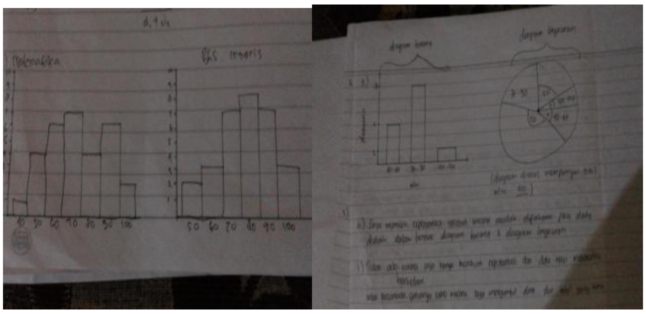
Researcher : Is there a difference in determining the average and median?

Interviewee : Different formula ma’am.

Researcher : Before using the formula, what should be done on the data?

Interviewee : Nothing ma'am, is the same as the average. To determining the median value I take the data center.

(3) Related to the second mode is the mode of the subject states that the value of most appear and younger determine the mode by looking at the highest bar chart. (4) In the phase represents the data in the form of charts or graphs, the first subject can represent data in the form of pie charts or graphs, while subject to the two cannot represent data, this may happen because they do not know how to draw a good diagram. (5) In the analyze phase and interpreting data in the two subjects have not been able to analyze and interpret every value-value statistic obtained in accordance with the context. This indicates that the subject has not been able to link her internal network when analyzing and resolving problems or represent data.



V. CONCLUSION

Based on the results obtained in this study, it can be concluded: in the reasoning process of describing the data students can identify the facts on the question asked, but requires the stimulus of researchers. The reasoning process of the students in organizing and reducing data is only the first subject that can sort and group the data appropriately. Statistical reasoning process of the subject in the data representing the first subject can be represented well in the form of charts and graphs, while the second subject cannot represent the data in the form of charts or graphs. Statistical reasoning process of analyzing and interpreting the subject in the second data subjects cannot draw conclusions and interpret the value statistic in context well. The second subject had a median-related reasoning is wrong with stating the average and median alike.

VI. SUGGESTION

Based on the above conclusions, it is recommended that some of the following:

1. In teaching statistics, high school teachers should use static reasoning stage, so that students can be trained reasoning as early as possible

2. In teaching mathematics and statistics teachers should pay attention to the reasoning process and designing a model student and learning methods by considering the mathematical abilities of students vary.

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ME – 34

Facilitating Students From Inadequacy Concept in Constructing Proof to Formal Proof

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Abstract— This article aims to describe in correcting errors experienced by students in constructing mathematical proofs related on concept of numbers. Research was conducted on students who have taken Number Theory courses at the University of Sultan Ageng Tirtayasa Serang-Banten. The research data obtained by asking the students who have worked on the mathematical proof problems, then proceed with the interview-based questions. The focus of the discussion of this article is to correct errors in constructing proofs when students' answer is right at the first step of proof, but not connected with other mathematical concepts that support the proof. Based on this research, facilitating the student who has the inadequacy of the concept can be done through the following steps: 1) raise awareness that there is an error in constructing the proof, 2) encouraged to think of reflection, and 3) help to get directions or strategies of proof. The flow of the correcting process, starting with correcting concepts with examples, correcting the pattern in the form of formal logic, symbolization, and then inserting to Representation System Proof (RSP).

Keywords: *Proof Construction, Formal-proof, Inadequacy Concept, Awareness, Reflection*.

I. INTRODUCTION

The process of proving a mathematical proposition is a sequence of mental and physical actions, such as writing, thinking tobegin the proof, draw diagrams, to reflect on previous actions or trying to remember the example. The process of proof formation of a theorem of or statement is more complex than the proof itself [1]. Therefore, teacher is needed for facilitating in learning mathematics thus facilitate students in mathematical proofs. In mathematics, one of the teachers'aid to help the students in order to make it easy to perform mathematical proofs is to make it into a tangible proof [2]. So, teaching assistance on mathematical proof to the students can be done gradually and trying to create proof into something tangible.

Griffiths (in [3]) states that a mathematical proof is a formal and logical way of thinking that starts with axioms and moving forward through logical steps to arrive at a conclusion. Based on these definitions, provide properties that mathematical proof should be logical. Logical mean, it is accordance with the rules of inference so the conclusion is valid. Therefore, the processes that occur in constructing proofs are using the rules of inference from the known, which then connects with the facts or other mathematical concepts that lead to the conclusion that is intended to prove.

Research in improving mathematical proof by the students has been conducted by several researchers ([4], [5], [6],[7], [8]). Komatsu's research [4] on elementary school students and Komatsu et al. [5] to high school students, both were studying mathematical proofs by providing a problem to build a simple conjecture, then submit a counter-example of the problem. With a counter-example, students are encouraged to indicate whether the conjecture they built is right or wrong. Thus, correcting errors in constructing mathematical proofs can be done in various ways, so it can force the students to do reflective thinking. Selden and Selden [6] conducted a study about improving mathematical proof of the student by asking students to assess and validate the wrong mathematical proof. The result is the validation of proof done by the students can be effective in improving the learning of mathematical proof. This is because in validating the wrong proof, it turns out that the students were doing reflective thinking processes. Andrew's research [7], so that with such a device,studentsare capable of knowing their mistakes and hopefully will correct the error of the proof. Stylianides & Stylianides [8] revealed that the learning stages with Conceptual Awareness Pillars (CAPs) were able to aware students to the concepts associated with mathematical proof by giving the challenge in the form of a counter-example.

Preliminary research conducted by [9], schemes of students thinking in constructing a formal proof can be categorized and modeled in four quadrants student thought processes, namely: (1) Quadrant I, able to make correct think schema; (2) Quadrant II,the student who suffered concepts insufficiencies caused by not doing reflection so that the necessary concepts can be used completely; (3) Quadrant III, experiencing misconception due toinsufficienciesofprior knowledge and not knowing the correct proof steps(4) Quadrant IV, incorrect logic that caused by the prior knowledge of its use is not in accordance with the structure of the expected proofs. Therefore, there is a need for a study of the transition of students from Quadrant II, II and IV towards Quadrant I. Based on the above, this article aims to describe and correct errors experienced by students in the construction of mathematical proofs of Quadrant II to Quadrant I.

II. METHOD

The present study is qualitative research which aims at constructing proof. This of the six students who were used as research subjects, all students experienced errors in constructing the proofs above. Proofs construction made by students can be categorized into three types, namely: 1) right at the first step of proof, but wrong in connecting with the other mathematical concept that support the mathematical proof, 2) have not bring up the initial step of the right proof, so they are not capable to construct the proofs well, and 3)make mistake in the first step in choosing the proof method, so they are not capable to construct the proofs well. The focus of the discussion in this article is to correct errors in constructing proofs when students were right at the first step of proof, butwrong in connecting it mengoneksikan with other mathematical concepts that support the proofs.

Research was conducted to the students at the University of Sultan AgengTirtayasa who have taken Number Theory courses. Students were given the opportunity to work on the proof problems, and then proceed with the interview-based questions. The research subject is taken from the students who were right at the first step of proof, but wrong in connecting it with other mathematical concepts that support the proof. Analysis of data is using constant comparison techniques, which is taking two students who have characteristics with the similar mistakes in constructing a mathematical proof.

Instruments used are in the form of questions adopted from [8]. Here's the question: Given n as positive integer. Prove "If n^2 is multiples of 3 then n is multiples of 3". To demonstrate that improvement has managed to improve the proofs construction, students were asked to construct a proof of other similar problem, namely: Given n is positive integer. Prove "If n^2 is multiples of 5 then n is multiples of 5"

III. RESULTS AND DISCUSSION

Students who construct the proof in the initial step correctly, but wrong in connecting it with other mathematical concepts that support the mathematical proof, experienced by Students-F and Student-K. Here are the mathematical proofs along with the analysis of deficiency as the result of the thinking process of Student-F, as follows:

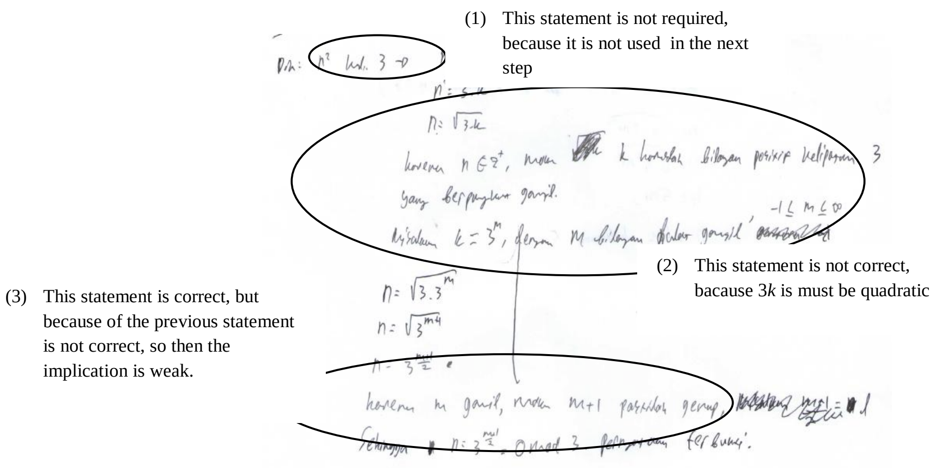

FIGURE 1. PROOF CONSTRUCTION OF STUDENT-F

Based on Figure 1 above, it appears that there is an inadequancy of the concept in the proof constructions of the Student-F. These inadequancy of the concepts occurred in inferring, looking for a relation with rank numbers. It should accommodate with the perfect squares numbers, but the Student-F make accommodations with rank numbers which is the rank of cardinal number 3 with the rank of an odd number. Therefore, efforts are needed to improve this wrong process. The wrong process is the result of lack of proper connection between n as positive integers with 3k which is the number in the root. This is what isasked to the Student-F as follows:

Researcher (R): Here the positive numbers k is the multiples of odd number, why choose odd number?

Student-F (F): Because if suppose it is even, then root-number is odd, And if odd then root-number is rational number

To track Student-F's understanding in constructing proof, carried out a series of questions that answered by Student-F as in Figure 2. That process started with an inquiry about numbers as an example that satisfies the theorem proved. Numbersas an example which is mentioned by the Student-F is 36. The number was able to create cognitive conflict in the Student-F's scheme of thinking, because he has to analyze that 36 = 3 x 12 = 3 x 4 x 3. In this way, it was able to bring Student-F to realize that there is an error in constructing the previous proof.

R:Should be it (odd rank)?, Earlier, it was for example 36…
F: 36 = 3 multiplied by.... 36 = 3 multiplied by 12.... Yeah Sir

By realizing his mistake, it makes the condition of disequilibrium in student-F's thinking scheme, which resultedan encouragement on Stundent-F to do reflection. Reflection is aided by asking which multiples of 3 is and making use the greater numbers as an examplewhich is a multiples of 3, namely 81 and 144. Student-F was able to analyze that $81 = 3 \times 3^3$ and $144 = (12)^2 = (4 \times 3)^2 = 3^2 x4^2$.

R: So how is the characteristicshould be..how k is should be ...?
F: [thinking ....]
R: Earlier you mentioned 36, try it now with ... 81. Try again what it means to be a multiple of 3?
F: It means, one of the factors is 3.
R: One of the factors is 3, yeah. Or simply, 12 ismultiples of 3 because of what....
F: 3 multiplied by a number, the result is 12.
R: 18 ismultiples of 3, it means..?
F: 3 multiplied by a number, the result is 18

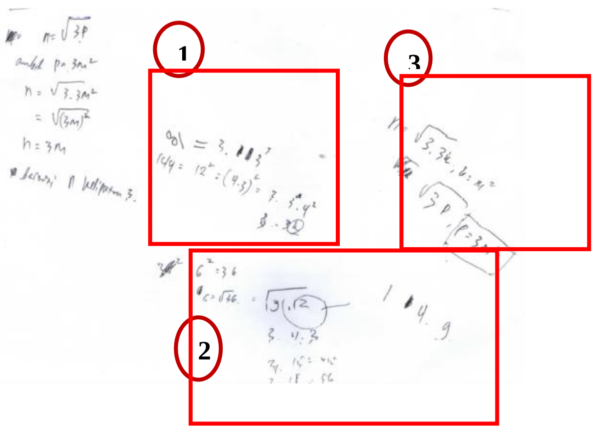

FIGURE 2. STUDENT-F'S IMPROVEMENT PROCESS IN CONSTRUCTING PROOF

Writing the number $81 = 3^2 \times 3^2$ and $144 = 3^2 x4^2$ can makeStudent-F able to read that there is a pattern of numbers that the square numbers multiples of 3 patterned 3^2 times another square numbers. So, Students-F makes the symbolism of the number pattern to be used in improving the mathematical proof construction.

R: Now think of the form how should be like this(odd rank), whether it should be ranked or simply multiplied

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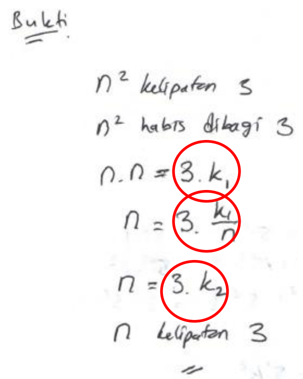
F: Well.... (Thinking long enough) ... .3 multiplied by 3 times the square number, Means, n = root of 3p, p = 3m^2, meaning n = root of (3 3 m^2)
R: Why is p equal to 3 m^2, what is the reason?
F: First, n is positive number, integer, then 3 must be multiplied by 3 m^2, so if taking its root yields integer too
R: what is p?
F: p is integer

Based on the above, Student-F through the process in improving the proof construction begins by looking for the number n that satisfies the statement. It aims to reduce the degree of abstractness the statement proved. Furthermore, from the numbers that meet the requirement of the statement, he traced the pattern of numbers that appear. Then proceed with symbolyze the variable n, accordance with the pattern of numbers found in the previous step. Furthermore,he is symbolizing the inserted variables into the system that proovedearlier.

Furthermore, it will discuss about the mathematical proof along with the analysis of deficiency as the resultof the thinking processof Student-K.



1) Not declare that $k_1$is positive integer
2) Not declare that k_1/nis positive integer
3) Not declare that $k_2$is positive integer

FIGURE 3. PROOF CONSTRUCTION OF STUDENT-K

Based on Figure 3 above, it appears that the proofwhich is constructed byStudents-Khas an inadequancy on the concept. These inadequancy occurred in inferring when looking for a relation, in order the number *n* is 3 times a constant. However, the Student-K did not notice that the constants must be integers, so it makes division for k_1 divided by n to obtain a new constant. Therefore, it is needed an effort to improve the wrong process.

To track student-K's understanding in constructing proofs, it isconducted a series of questions that are answered as in Figure 4.

Researcher (R): Why Rohim dividing k_1 by n, here?
Student-K (K): For this sir ... So it can be in the form of multiplication by 3
R: The form k_1 / n, what kind of number is it?
K: Integer ... It's because the n is integer
R: Are you sure?
K: ... mmm ... mmm ....

The question turned out to be capable of generating cognitive conflict of thinking schemes in Student-K. This is indicated by the appearance of disequilibrium. Thus, the students are forced to think reflectively. In reflective thinking, to reduce the level of abstraction of the theorem, they are asked about the example that satisfies the theorem. The studentslisted some positive square numbers, and thenmentioned numbers 9, 36, and 81. Student-K connecting the three numbers with the numbers 3 and were able to read that there is a pattern of numbers.

Q: Is there a pattern?
K: [working ...]
P: Are you sure ...?
K: yes, sir. The pattern is$3^2.k^2$

Based on the above, student-K through the process in improving the proof construction begins by looking for the number n that satisfies the statement. It aims to reduce the degree of abstractness the statement proved. Furthermore, from the numbers that meet the requirement of the statement, he traced the pattern of numbers that appear. Then proceed with symbolyze the variable n accordance with the pattern of numbers found in the previous step. Furthermore, he is symbolizing the inserted variables into the system that prooved earlier.

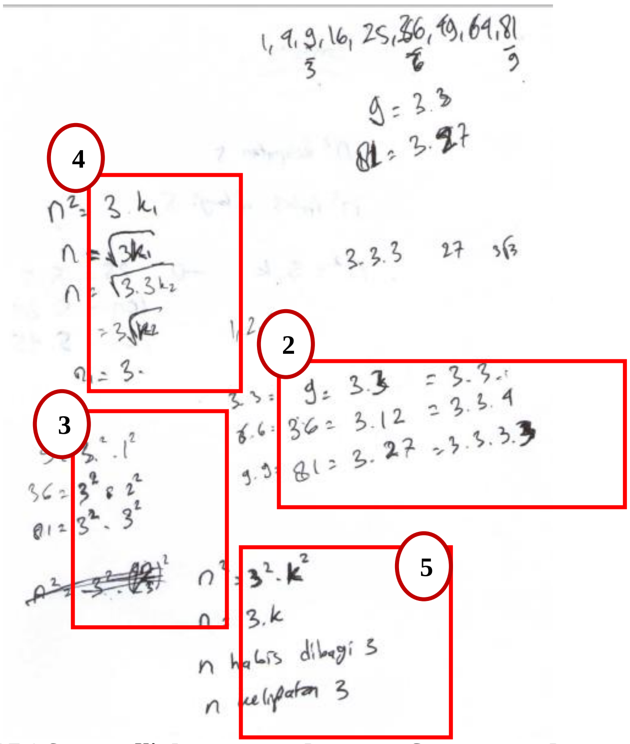


FIGURE 4. STUDENT-K'S IMPROVEMENT PROCESS IN CONSTRUCTING PROOF

Based on the discussion of the proof construction that was constructedbyStudent-F and Student-K, it can be obtained work-flow improvements as follows:

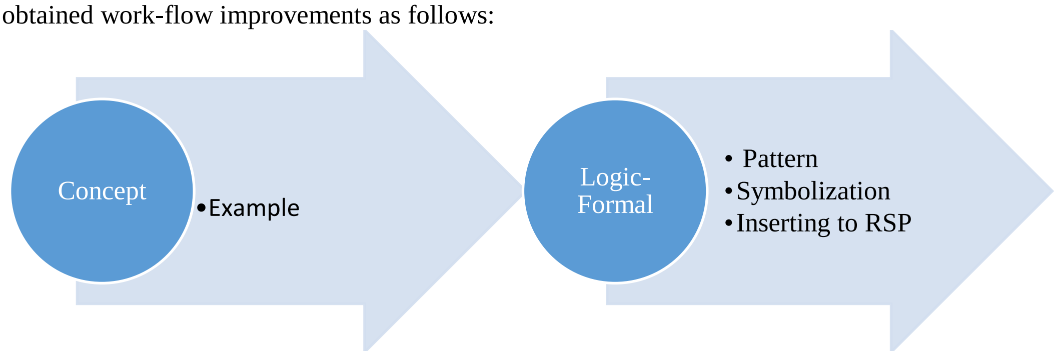


FIGURE 5. FLOW PROCESS IMPROVEMENT OF PROOF CONSTRUCTION FOR STUDENTS EXPERIENCING AN INADEQUANCYCONCEPT

IV. CONCLUSION

The research revealed that in order to correct mistakes in constructing mathematical proof for the students who are right at the first step of proof, but wrong in connecting with the other mathematical concept, can be done through the following steps: 1) raise awareness that there is an error in the proof that has been constructed, 2) encouraged to think reflection, 3) helping to get directions or proof strategies. The flow of the improvement processis, starting with correcting concepts with examples, and then correct the patter of formal logic, symbolization, and inserting to Representation System Proof (RSP).

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Adaptive Reasoning Junior High School Students In Mathematics Problem Solving

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Abstract- The purpose of this research was to determine adaptive reasoning on junior high school students grade VIII in mathematics problem solving. The method used is a qualitative method of data analysis techniques triangulation. The results showed adaptive reasoning students in mathematics problem solving are as follows: (a) formulate what is known of the mathematical problem given, (b) formulate the unknown, (c) formulate the terms in question, (d) identify strategies to solve mathematical problems, (e) be able to write formulas to help solve mathematical problems given, (f) found the final result of a mathematical problem, (g) write the conclusion of a mathematical problem, (h) write the reasons of the strategy being obtained, (i) write the reasons for their conclusion, (j) examine the solution back.

Keywords: *adaptive reasoning, mathematics problem solving*

I. INTRODUCTION

During this time the mathematics is still considered difficult to be understood by students. Although education is now growing quite rapidly compared with education antiquity, it is supported by the development of teaching aids and learning mathematics media that can facilitate students in understanding mathematics. In face of science and technology development so fast this time, the necessary human resources that are reliable and capable competent globally [1]. With competition so tight that each person required to develop the mindset associated with reason.

National Council of Teachers of Mathematics (NCTM) states that the purpose of learning mathematics is to develop mathematical communication skills, mathematical reasoning, mathematical problem solving, mathematical connections and mathematical representations [2]. Basically, every student is required to hold the mathematical purposes, but in reality, not all students are able to hold all existing mathematical purposes. This relates to the smoothness during the learning process takes place. But of all the goals that a student needs to hold one is about the mathematical skills of mathematical reasoning abilities.

Reasoning is a major component in mathematics. Ross in [3] saying that, that should be emphasized as a foundation in mathematics is reasoning, if reasoning ability is not developed in the students, then the mathematics will only be a problem for students while following a set procedure of learning and imitating the example without thinking about why math makes sense.

Reasoning is divided into several types, including adaptive reasoning, quantitative reasoning, intuitive reasoning, and there is still another reason. Students are said to be capable of adaptive reasoning when students are able to think logically about the existing problems, estimating the problem until students can conclude. Besides the adaptive reasoning there is a process in which a student is required to be able to give a reason for what the students have been working on. Adaptive reasoning also interacts with the process of understanding the other, especially in the problem solving process. Problem solving skills can be hold students well if students also hold the mathematics skills, one of which is the ability to adaptively reason.

Based on observations the author on one of the junior high scholl in Purworejo district, found that when students solve a problem, there are some students who can predict these problems until it can conclude and give the reasons of what the students do. But there are also students who can only infer a problem or otherwise, the student can only estimate it. This process is already leading to adaptive reasoning, but does not necessarily indicate that the student has developed adaptive reasoning to solve a mathematical problem. It can be concluded that the adaptive reasoning owned by students is very varied. This can be seen when students solve a problem, many ways in which students in solving the problem.

Research related adaptive reasoning had been done by [4], the results showed that male subjects tend to be less careful and thorough in solving mathematics story, it supports the skills to suggest that female are superior to male in accuracy, thoroughness, and exactitude of thinking. Based on the above, authors are encouraged to conduct research related to adaptive reasoning students in solving mathematical problems. The purpose of this study was to determine the adaptive reasoning junior high scholl students grade VIII in mathematical problem solving.

II. Adaptive Reasoning

Mathematics has a great relationship closely related to reasoning. Ministry of Education in [5] states that matter of mathematics and mathematical reasoning are the two things that can not be separated, ie, matter understood through reasoning and mathematical reasoning to understand and learn the material drilled through mathematics. Reasoning can also build mathematical understanding about what he saw, they think and they conclude in mathematical problem solving.

Mathematical reasoning according to Ball & Bass [3] are the basic skills of mathematics and is required for some purpose, to understand mathematical concepts, use of mathematical ideas and procedures flexible. Students who use reason ability in learning mathematics will find the learning of mathematics more meaningful, because the mathematical reasoning would establish a new relationship with the relationship that has been previously owned.

In mathematics there are two kinds of reasoning, inductive reasoning and deductive reasoning. John Stuart Mill stated that the induction of an activity in which we conclude that what we know to be true for special cases will also be true for a similar case for certain things [5]. While deductive reasoning is a way of drawing conclusions from statements or facts that are considered correct use logic. This reasoning tend to use theories or formulas that have been proven to be true deductively.

Adaptive reasoning included deductive reasoning conclusion withdrawal ways is based of facts which are true logician, and also includes inductive reasoning based on observation generalization of some cases. Adaptive reasoning refers to the ability to think logically about the relationship between the concept and the situation [6]. Meanwhile, according to [7], adaptive reasoning is the ability to think logically about the relationship between the concept and situation, ability for reflective thinking, the ability to explain, and the ability to provide justification. So it can be said that the adaptive reasoning is the ability to think logically about the relationship between concepts and procedures makes sense generalized manner, so as to demonstrate the possibilities in problem solving, as well as allow the differences of opinion must be resolved in a way that is reasonable.

Students are said to be capable of adaptive reasoning when students are able to think logically about the existing problems, estimating the problem until students can conclude. In the adaptive reasoning be a process in which a student is required to be able to give a reason for what the student has done. Adaptive reasoning also interacts with the process of understanding the other, especially in the problem solving process. Problem solving is a mental process and requires a high level of more complex thought processes including reasoning [8].

Some experts have proposed indicators to determine the adaptive reasoning students in solving mathematical problems. In this research the authors formulate indicators adaptive reasoning such that when the student is able to: 1) write an allegation of mathematical problems, 2) draw a conclusion of mathematical problems, 3) give the reasons for the outcome of mathematical problems, 4) to re-examine the results of the settlement, 5) finding algorithm on a mathematical problem.

III. Research Methods

The research is a qualitative research with descriptive design. Descriptive is a collection of data in the form of words, pictures and does not contain the figures in it [9]. The study was conducted in September-November 2015 on the junior high scholl 4 Purworejo. Subjects were 3 students of grade VIII F ie students who can solve problems and have adaptive reasoning. Subject retrieval is done by purposive sampling and snowball sampling [10].

The instrument used consisted of the main instruments and supporting instruments. The main instrument is the researchers themselves, while supporting instruments is a matter of the test, the observation sheet and interview guidelines. Data collection is done by test, observation, interview techniques and field notes. Data analysis technique used is based on the model of Miles and Huberman [10]: (1) data reduction is choosing the data needed by researchers, the data reduction requires triangulation techniques, (2) data display, (3) conclusion.

IV. RESULTS AND DISCUSSION

In this research the researchers choose three subjects based on test results at an early stage. In this research, there are four forms of data at the time of the research activities taking place, that the results of the students' answers, the result of observation, interviews and the results of field notes. Four of these data will become a measurement to deduce how the adaptive reasoning in solving mathematical problems in grade VIII junior level.

Giving matter on the subject is done after school hours starting from 12:30 o'clock. The material was tested in the form amounted to 2 questions about the story with the material Quadrilateral. When students have completed work on the next step is an interview based on the results of the students' answers. By the time the students do the problems, researchers conducted observations and write field notes for further data. Under this problem sheet that I use in this study.

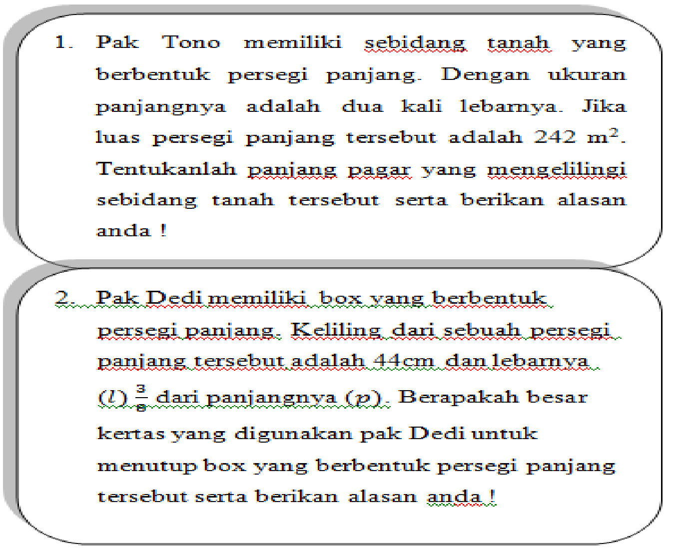

1. Pak Tono memiliki sebidang tanah yang berbentuk persegi panjang. Dengan ukuran panjangnya adalah dua kali lebarnya. Jika luas persegi panjang tersebut adalah 242 m^2. Tentukanlah panjang pagar yang mengelilingi sebidang tanah tersebut serta berikan alasan anda !
2. Pak Dedi memiliki box yang berbentuk persegi panjang. Keliling dari sebuah persegi panjang tersebut adalah 44cm dan lebarnya (l) $\frac{3}{8}$ dari panjangnya (p). Berapakah besar kertas yang digunakan pak Dedi untuk menutup box yang berbentuk persegi panjang tersebut serta berikan alasan anda !

Figure 1. Research Problem Sheet

The first phase is done by the students is to formulate what is known of the mathematical problem. This is shown by the results of the answers to the student in point 1 be presented in the figure below.

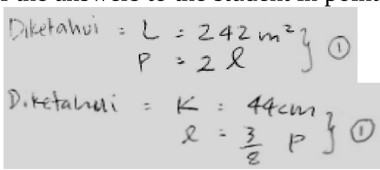


Figure 2. Writing Things to Know

The second phase is done by these students is to formulate the unknown of mathematical problems. This can be demonstrated by the results of the students' answers based on the question contained in point 2 of which will be presented in the figure below.

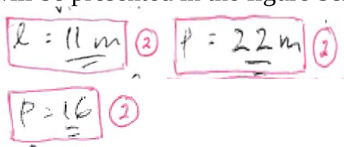
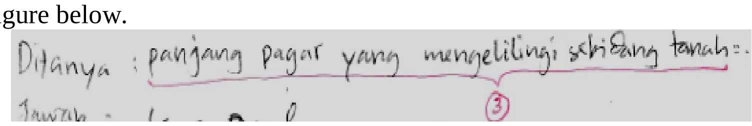


Figure 3. Formulate Things Not to Know

The third stage is done by these students are able to formulate the terms of those asked in a given mathematical problem. It can be shown in the results of the students' answers on point 3 which will be presented in the figure below.



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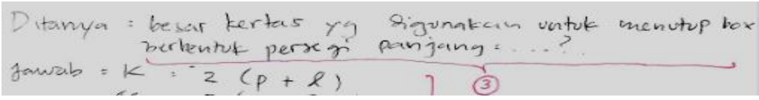
Ditanya : besar kertas yg digunakan untuk menutup box berbentuk persegi panjang : ... ?
Jawab : K = 2 (p + ℓ) ③

Figure 4. Formulate Asked Things

The fourth stage is done by these students are able to find strategies to solve mathematical problems given. It can be shown in the results of the students' answers are contained in point 4, which will be presented in the figure below.

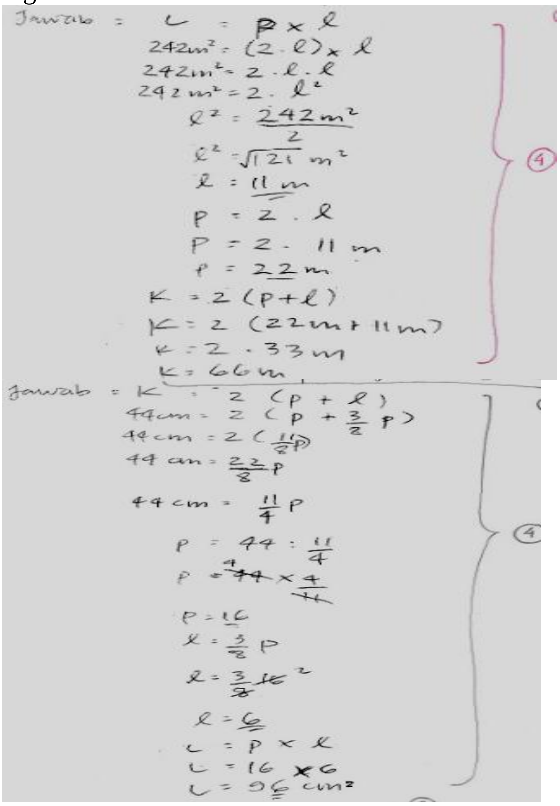
Jawab : $L = p \times \ell$
$242 m^2 = (2 \cdot \ell) \times \ell$
$242 m^2 = 2 \cdot \ell \cdot \ell$
$242 m^2 = 2 \cdot \ell^2$
$\ell^2 = \frac{242 m^2}{2}$
$\ell^2 = \sqrt{121} m^2$
$\ell = 11 m$
$p = 2 \cdot \ell$
$p = 2 \cdot 11 m$
$p = 22 m$
$K = 2 (p + \ell)$
$K = 2 (22 m + 11 m)$
$K = 2 \cdot 33 m$
$K = 66 m$ ④
Jawab : $K = 2 (p + \ell)$
$44 cm = 2 (p + \frac{3}{2} p)$
$44 cm = 2 (\frac{11}{2} p)$
$44 cm = \frac{22}{8} p$
$44 cm = \frac{11}{4} p$
$p = 44 : \frac{11}{4}$
$p = 44 \times \frac{4}{11}$
$p = 16$
$\ell = \frac{3}{8} p$
$\ell = \frac{3}{8} 16$
$\ell = 6$
$L = p \times \ell$
$L = 16 \times 6$
$L = 96 cm^2$ ④

Figure 5. Finds Possible Settlement Strategy

The fifth stage is done by these students are able to write the formula to help solve mathematical problems given. This can be demonstrated by the results of the students' answers on point 5 which will be presented in the figure below.

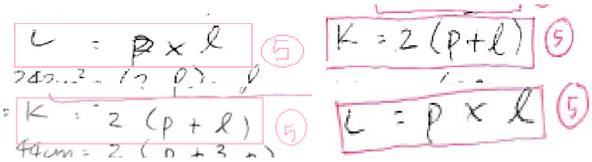
$L = p \times \ell$ ⑤ $K = 2 (p + \ell)$ ⑤
$K = 2 (p + \ell)$ ⑤ $L = p \times \ell$ ⑤

Figure 6. Writing Formulas

The sixth stage is done by these students are able to get the final result of a mathematical problem. It can be shown in the results of the students' answers on point 7 which will be presented in the figure below.

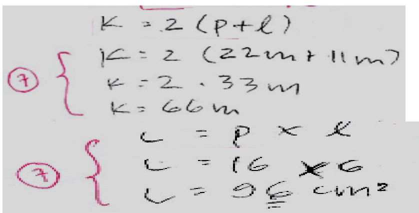
$K = 2 (p + \ell)$
⑦ $K = 2 (22 m + 11 m)$
$K = 2 \cdot 33 m$
$K = 66 m$
$L = p \times \ell$
⑦ $L = 16 \times 6$
$L = 96 cm^2$

Figure 7. Subject Acquiring Solutions

Seventh stage is done by these students are able to write the conclusion of a given mathematical problem. It can be shown in the results of the students' answers in point 8 which will be presented in the figure below.

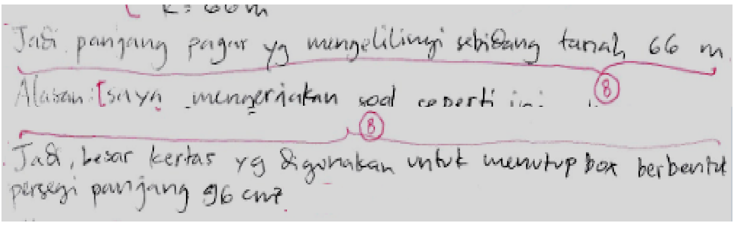

Figure 8. Writing Conclusion

Eighth stage is done by these students are able to write down the reasons of the strategy to get students of mathematics problems. It can be shown in the results of the students' answers on point 9 which will be presented in the figure below.

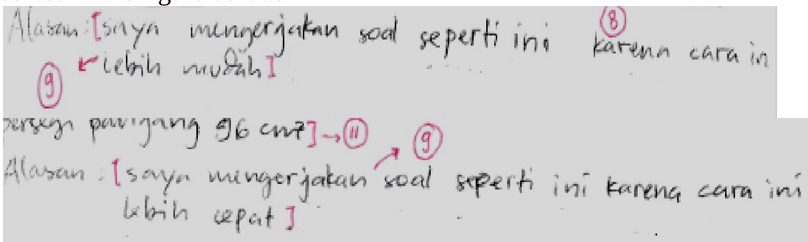

Figure 9. Writing Reasons On Strategies Used

Ninth stage is done by these students are able to write down the reasons about conclusions that students get from mathematical problems. It can be shown in the results of the students' answers on point 10 which will be presented in the figure below.

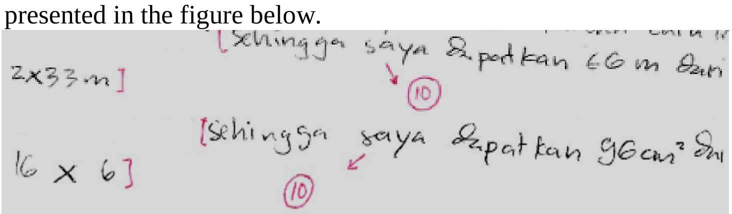

Figure 10. Reasons Writing On Conclusion

Tenth stage is done by these students are able to check the answer back so that no one counted on the job. This is indicated by the results of the interview are presented in the figure below.

Peneliti	:	Berarti kalau misalnya lebih cepat itu apa jawaban kamu sudah benar?
Subjek	:	Eee.. sudah mbak
Peneliti	:	Kok kamu sudah yakin itu dari mana?
Subjek	:	Soalnya tadi sudah diteliti
Peneliti	:	Apanya yang diteliti?
Subjek	:	Eee.. jawabannya
Peneliti	:	Jawaban? Terus gimana jawaban kamu? Sudah benar?
Subjek	:	Benar
Penelliti	:	Yakin?
Subjek	:	Yakin
Peneliti	:	Oke, kalau seperti itu berarti kamu sudah yakin sama jawaban kamu ya?
Subjek	:	Ya yakin
Peneliti	:	Kenapa kok yakin?
Subjek	:	Soalnya sudah diteliti
Peneliti	:	Apanya yang diteliti?
Subjek	:	Jawabannya
Peneliti	:	Terus jawabannya gimana? Gimana dek?
Subjek	:	Benar
Peneliti	:	Benar dari? Sudah yakin benar?
Subjek	:	Sudah

Figure 11. Subject Check Solution Back

The interview above indicates that the subject has been check solution back. Subject believe the answer is correct.

From the above it can be concluded that the reasoning adaptive performed students in solving mathematical problems are (a) to formulate what is known of the mathematical problem given, (b) determining the unknown, (c) formulate the terms in question, (d) find strategies for solving mathematical problems, (e) be able to write formulas to help solve mathematical problems given, (f) found the final result of a mathematical problem, (g) write the conclusion of a mathematical problem, (h) to write the reasons of the strategy being obtained, (i) describes the reasons for their conclusion, (j) checking back solution. Based on the conclusions from these results, it can be done further research associated with adaptive reasoning process of the students in solving mathematical problems.

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ME – 36

Active Learning Optimization to Improve Students Critical and Creative Mathematical Thinking

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***Abstract*—**The purpose of this paper is to describe how mathematics educators to face of ASEAN Economic Community (AEC) by optimizing active learning to improve students critical and creative mathematical thinking. Human resources should be formed in this era is that having a competitive mental. Education is one of solution to developing knowledge and skills so as to create the character of a good human resources. In essence, learning is not transfer of knowledge activity but a process of interaction between the students and his environment. Learning paradigm in the 21st century refers to active learning, where educators as facilitators. Usually, traditional teaching is concentrated to lower order thinking skills (recall and basic). Improve critical and creative thinking skills of student is the focus in mathematics education since critical and creative thinking skills is the higher order thinking skills. Kinds of active learning methods: (1) Individual exercises, like the one minute paper, daily journal, reading quiz; (2) Socrates Method, like quiz/test questions; (3) The direct input, like finger signal, flash cards, quotations; (4) Motivator critical thinking; like the pre-theoretical institutions quiz, puzzles/paradoxes; (5) Collaborations, like discussions, note comparison, evaluation of another students work; (6) Cooperative learning, like cooperative group in class, active review sessions, work at the blackboard, concept mapping, visual list, jigsaw group project, role playing, panel discussions, debate, games.

Keywords: *active learning, critical mathematical thinking, creative mathematical thinking*

I. INTRODUCTION

Education is a determinant of the development and progress of a nation. In general, the purpose of education is providing a usable environment allows students to develop the potential and ability to optimally so that they can work for themselves, society and nation [1]. Lickona [2] suggest that the basic fundamental purpose of education according to Socrates is able to form human being smart and better, is aligned with that of education in Indonesia is aimed at educating the nation. The main focus in establishing the knowledge and skills of human resources of this nation that is by education. According to the UNDP report, the value of Human development index, Indonesia in 2014 amounted to 0.684 rated 111 of 188 countries while in ASEAN under Singapore, Brunei, Malaysia and Thailand.

Mathematics is a lesson that did not evolve naturally on students because mathematics is an abstract, rigor and coherence. Mathematics will be understood by student if the educator uses in learning the proper way. Referring to the constructivist learning theory, mathematics studied cooperatively and educators as facilitators. A student will not be able to understand the math if students allowed to find out their own without help of the teacher so that students need scaffolding in learning mathematics. Mathematics has many roles in life, therefore educators should establish that students who have creative and critical thinking skills in studying mathematics.

In the face of free trade and competition as well as the face of the times in the 21's era, there are four skills to be developed by educators to students by National Education Association are critical thinking, communication, collaboration and creative thinking. With attention to low Indonesia's human development index necessary to do an investigation of Indonesian education, especially in mathematics learning. According to survey results Trend in International Mathematics and Science Study (TIMSS), Indonesia began in 1999 in the position of 34 from 48 countries, in 2003 in the position of 35 from 46 countries, in 2007 in the position of 36 from 49 countries and in 2011 in the position of 36 from 40 countries. While according to a survey from Program for International Student Assessment (PISA), studies committed from 2000 position Indonesia of 39 from41 countries, in 2003 in the position of 38 from 40 countries, in 2006in the position of 50 from 57 countries, in 2009 in the position of 61 from 65 countries and in 2012 in the position of 64 from 65 countries [3]. Based on these survey results it appears that Indonesia mathematics achievement in the world cannot be proud.

Education studies has done by the government of Indonesia on the curriculum changes from 2004 that is competency-based curriculum, curriculum 2006 that Education Unit Level Curriculum and national curriculum in 2013 that its use is still not evenly distributed in Indonesia. This is caused by the pros and cons from the education unit. The curriculum applied reflected the education in the 21st century. However, on the ground of learning, educators have not been fully implemented as expected by the learning curriculum. There are still some educators who still use traditional learning in mathematics learning. In traditional learning to the student memorization of understanding so that not returning critical and creative thinking students in mathematics learning. Bransford in Sukarno [4] stated that the most fundamental problem is the traditional education failed to produce the ability to solve problems in life. Because traditional learning only gives simplified and decontextualized problems and not relevant to daily life. While the expectation is that the learning of mathematics education can be implemented in daily life so that mathematics is not considered as an abstract science.

Of the problems that exist in the Indonesian education system are methodologically then there are several ways needed to be done. One strategy that has been, is and will be applied is active learning. Active learning can develop and increase critical and creative learning. Critical and creative learning are higher order thinking skills (HOTS). Minister Regulation the Republic of Indonesia 22 of 2006 of the content standards stated that Mathematics is given to all students to equip them with the ability to think logically, analytical, systematic, critical, and creative, as well as the ability to cooperate. The purpose of this paper is to describe how mathematics educators to face of AEC by optimizing active learning to improve students critical and creative mathematical thinking and this paper is expected to be used as consideration in choosing a model of learning that human resources can be compete in the era, especially for educators who want to grow and develop aspects of students critical and creative mathematical thinking.

II. ACTIVE LEARNING

Learning is something that happens as a result or consequence of experience and precede changes in behavior [5]. Then learning can be defined as the process of abstracting past experience with knowledge gained is now forming a new knowledge that will change the behavior of a depressed individuals. While learning is a process of creating conditions conducive for teaching and learning communication interactions occur between educators, students, and other learning components to achieve the learning objectives. Active learning essentially been there since the time of Socrates, but in fact active learning developing new else in the 21st century.

Active learning is one alternative in cultivate students' critical and creative thinking. Which comes from learning and creative. What is meant here is the interaction of learning and learning communication between educators, students, and other learning components to achieve the learning objectives. While that is activities engagement students in the learning process. So we can say active learning is a model / strategy in learning activities by using the full potential of students optimally, with the aim that they can achieve satisfactory results or objectives according to the personality characteristics possessed by the student [6]. Active learning is very important according to the statement proposed by Silbermen [7] in his book, that "More than 2400 years ago Confucius stated: what I hear I forget, what I see I remember and what I do I understand. From this statement it can be said that active learning can provide a deeper understanding to students compared to learning that is not active as teacher-centered learning or traditional learning.

According to Meyers and Jones that “active learning derives from two basic assumptions: (1) learning its by its very nature an active process and (2) that different people learn in different ways.” Meanwhile, according to Simons that active learning has two dimensions, independent learning and active working [8]. From the opinion of experts, it can be concluded that active learning is learning in which students work active in collecting information learning so that educators as facilitators of learning, in active learning, we will not find another lecture for the students to dominate the classroom than educators, educator only duty deploying the learning process. Implement thinking skills and learning to the level of control of new knowledge and skills effectively are essential for students in active learning. In the active learning is expected to involve high-level skills such as creative and critical thinking are not just memorize, know or understand but also apply, analyze, evaluate and create. In active learning, there are three important goals that need to be fulfilled by educators at the beginning of learning: (1) building a team, aims to have the leaners are able to know each other between each other and will influence the creation of a spirit of cooperation and interdependence among participants students (2) the assertion, in terms of educators will be able to learn the attitudes, knowledge, and experience for the smooth students in the learning process (3) the involvement learn immediately, here educators will be able to generate early interest students in learning activities.

There are several methods used in active learning is student-centered learning, self-regulated learning, collaborative learning, learning-to-learn, problem-based learning (PBL), project-based learning, inquiry-based learning. Some of these methods has a characteristic, advantages and weakness of each. According to Paulson and Faust there are several options of active learning which is based on things related to the learning context [4]:

1. Individual Exercise like (1) The "One Minute Paper"; (2) The Muddiest (or Clearest) Point; (3) Effective Responses; (4) Daily Journal; (5) Reading Quiz; (6) Clarification Pauses; (7) Response to Demonstration or other teacher-centered activity
2. Direct input, like (1) Finger Signals; (2) Flash Cards; (3) Quotations
3. Mate, like (1) discussion; (2) Note Comparison/Taking; (3) Evaluation of Another Students Work
4. Question and answer like (2) Wait Time; (2) Peer Summary; (3) The Fish Bowl; (4) Quiz/Test Questions
5. Motivator Critical Thinking like (1) The Pre-Theoretic Institutions Quiz; (2) Puzzles/Paradoxes
6. Exercise Cooperative Learning like (1) Cooperative Groups in Class; (2) Active Review Sessions; (3) Work at the Blackboard; (4) Concept Mapping; (5) Visual Lists Jigsaw; (6) Group Project; (7) Role Playing; (8) Panel; (9) Discussions; (10) Debates; (11) Games.

III. STUDENTS CRITICAL AND CREATIVE MATHEMATICAL THINKING

Thinking is one of the activities that occur in human life continue. One example of thinking activities is when someone tries to find ways solve a problem. For example, Ani and three of her friend had a rectangular shaped cake, they want the cake is divided into four equal parts.

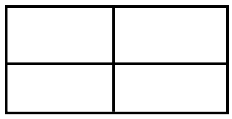


FIGURE 1

When they cut the cake they think is there any other way?

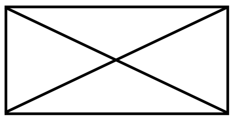


FIGURE 2

Or, what if?

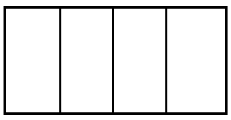
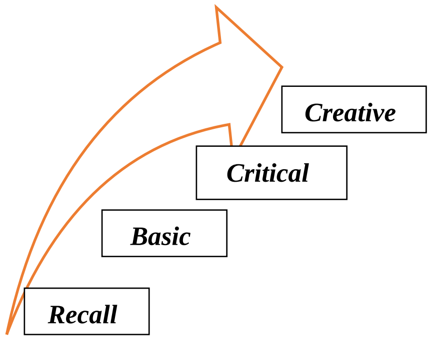


FIGURE 3

From these example it can be concluded that thinking is a mental activity that involves the brain's performance to an information that can lead to the development of an idea or concept.

There are some education experts argued about the meaning of thinking. Gestalt said that the thinking process cannot be observed using human sensory organs and thinking is a psychic activeness are abstract [9]. While Ruggiero stated that thinking is a mental activity in helping to solve problems, make decisions or satisfy curiosity. Based on the expert opinion that thinking is abstract mental activity in order to find solutions to a problem [10]. In general, that there are two levels of thinking, LOTS (Lower Order Thinking Skills) and HOTS (Higher Order Thinking Skills). LOTS a recall and basic while HOTS is a critical and creative. HOTS is expected ability in mathematics because it can form human resources have the critical and creative thinking skills. critical and creative thinking skills are skills needed in this era.



A. Critical Thinking

Critical thinking is one indicator of HOTS. There are some experts who express opinions about critical thinking skills, one of is Edward Glaser. Critical thinking by Edward Glaser in Fisher are: (1) An attitude would think deeply about issues and things that are within the reach of one's experience; (2) Knowledge of the methods of inspection and logical reasoning; (3) A kind of a skill to apply these methods [11]. Ennis in Feldman argues that critical thinking is the ability to give a reason and reflective focused on what is believed and done [12]. It can be said that critical thinking is analytical and reflective in check, connect, collect, organize, memorize, analyze information and evaluate a problem or situation then this could mean is able to draw conclusions from the data given and are able to determine inconsistencies and contradictions in the group data. If a student is able to think about what if in answer to non-routine math problems that young people have the critical thinking skills.

According to Glaser, while the foundation of critical thinking skills including the ability to [11]: (1) Know the problem; (2) Finding ways that can be used to address these problems; (3) Collect and collate the necessary information; (4) Know the assumptions and values that are not otherwise; (5) Understand and use appropriate language, clear and distinctive; (6) Analyze the data; (7) Assess the facts and evaluate statements; (8) Know the relationship between problems; (9) Appealing conclusions and similarities necessary; (10) Test the commonalities and the conclusions that someone grab; (11) Reconstitute the patterns of a person's belief is based on a broader experience; (12) Make an accurate assessment of things and certain qualities in everyday life.

Moreover, there are examples of some critical thinking styles are:

Explorer	See all sides of a situation or problem Identify the core elements of a problem or situation Want to know Looking for new development
Students	Intelligent Researching other solutions to a problem Doing task Correcting errors
Warrior	Accepting the challenge Persevering

	Faced with a difficult problem
Cicerone	Guiding others Looking ahead Planning a series of actions
Detective	Questioning the thoughts and actions tolerating uncertainty Pursuing elements of fact that are not clear

There are four strategies that can increase critical thinking skills, are:

1) The willingness to look at yourself
   There are several steps that must be done, are:
   a) Ask questions why. In other words, do not accept the things that are seen or heard away.
   b) Identify and resist your bias. Bias can lead to inaccuracies in perception. To eliminate it, we must continue to train our thinking muscles.
   c) Recognize your thought process, and skip unproductive thinking strategies and learn new strategies are effective. That is not affected by the different strategies used by others when they face problems or new challenges. Convince yourself that every person has a different strategy when faced with a problem or challenge.
2) Evaluation of are constantly
   Steps in this strategy, are:
   a) Getting other feeds from other sources. This means did not limit yourself, check or accept a perspective or input from others.
   b) Raised the quality of the existing answers. Each question has an answer that can be judged rightly or wrongly, try to find the best method to achieve a better answer or correct.
3) Constantly are not prejudiced
   Steps for this strategy, are:
   a) Accept other people who might have a different perspective. That is trying to position themselves to be someone else and feel the viewpoint used by the other person. Essentially tries to respect the other person's perspective.
   b) Finding agreement. If there is disagreement, trying to recollect and focus on opposite viewpoints that caused the disagreement.
   c) Recognizing that there are often some solutions to a problem. There is a way out of every problem. So never stop to find various way out of the problems existing.
4) Commitment to the decision taken
   Steps for this strategy, are:
   a) Creating limit of clear analysis. Starting from the basic assumption that obvious and then develop to the stage logical and reasonable.
   b) Get answers to the most credible, rather than waiting for total accuracy be assured that there are still many unknowns in this world, but if we want to try it will not be impossible, all that can be known and refined.
   c) Recognizing the need for agreement or consensus in creating your decision. Account the social context of decisions already taken. Unconscious in ourselves that we live in the real world rather than in cyberspace.

B. Creative Thinking

Hosnan [6] states that the other qualities that necessary developed on the Curriculum 2013 includes creativity, independence, cooperation, solidarity, leadership, empathy, tolerance and life skills of students to form the character as well as the increase of civilization and dignity of life of a nation. According Maite and Laura “Creativity is the capacity to create, to produce new things” [13]. Isaksen declared that creative thinking is a process of forming an idea related to aspects of fluency, flexibility, novelty, and original. While McGregor declared that creative thinking is a process that leads to new knowledge, new ways of know something [14]. Based on expert opinion it can be concluded that creative thinking is a mental activity used by someone to build on the ideas that generate new knowledge. Creative thinking usually caused by problems not ordinary that creative thinking is a process of construction of ideas that lead to the acquisition of new insights or new ways to produce a concept on the existing problems. In mathematics, students' creativity will appear when educators provide a non-routine problem for students. Creative thinking is rational and reflective. The activities carried out such unify ideas, create new ideas, and determine its effectiveness. The results of this thinking skills is something complex. Creative thinking also includes the ability to draw the conclusion that the end result is usually produced the new ones. Students who have high creativity in solving non-routine problems in mathematics will ask himself, Is there another way?

Pehkonen said creativity is not only found in learning the art, science and so on, but can also be found in the learning of mathematics [15]. Krutetskii declared that mathematical creative thinking ability is the ability to get the solution of a mathematical problem is easily and flexibly [14]. It can be concluded that creative thinking ability is the way an individual mathematical construct an idea in solving non-routine problems in mathematics. Characteristics of students who have a creative personality in Munandar by Csikszentmihalyi [1]:

1) The creative individual has the physical energy to fully concentrate on working for hours, and they also can be calm and relaxed depending on the circumstances.
2) Ability to convergent and divergent thinking
3) Having a combination of playfulness and discipline
4) Personal creative can alternately in issuing the imagination and fantasy but still thinking realist.
5) Shows tendency either introversion or extroversion
6) Have an attitude humble and proud of his work at the same time
7) Have a tendency psychological androgyny
8) Tends independently even perverse but could remain conservative and traditional
9) It is passionate when it comes to their work
10) Brush the open and sensitivity often makes him suffer when their work gets a lot of critical.

In general, students who have creative curiosity, interests and passions to get something done. They are more willing to take risks in trying to find something new of a problem. If they still think of a problem is still possible to get an answer in any other ways, then they will try.

IV. Active Learning to Improve Students Critical and Creative Mathematical Thinking

As the country became a member of ASEAN and Indonesia agreed AEC then require workers who have critical and creative thinking skills are able to contribute energy and thoughts for science, culture, technology, and prosperity of the nation. Cicero said that the character of the citizens is the nation's welfare [16]. This statement indicates that the skills and character of human resources shows the character of a nation, the welfare of a nation depends on the character of human resources. Creativity is a matter that can be established anywhere, one is in school. At school, the educator has a greater role in shaping the character of students. Educators can foster creativity, curiosity and motivation for students. Instead, educators can also cripple creativity, curiosity and motivation in students. This is because educators have more opportunities to excite or cripple creativity, curiosity and motivation of students rather than their parents. Educators have a duty to evaluate the work, attitude, and behavior of students.

In essence it must be recognized that educators cannot teach creativity but educators can allow creativity appear, nurture and excite growth. The most important way to encourage intrinsic motivation in school is establish classroom environment that is free of obstacles that can damage students self-motivated. In addition, the best way for educators to develop students’ creativity is to encourage intrinsic motivation. The meaning of intrinsic motivation here is the motivation that comes from within the student. Intrinsic motivation is very influential on the smooth running of the learning process and the results that will be obtained. This intrinsic motivation will grow if the educator can be a model for intrinsic motivation for the child to freely express their interests and personal challenge to solve a problem or complete a task. Moreover, to some extent educators can also teach the skills of creative ways of thinking confront problems creatively, or techniques to come up with original ideas. Educators should give the broadest possible opportunity for students to express their opinions. Let them freely express what they want to submit. Do not limit. Whether right or wrong, leave it alone. Later slowly educator directing or guiding students to gain knowledge and insight into the true Learning from experience that one sometimes it will make students become more remembered [1].

Has been mentioned before that active learning is a model approach that has types such as PBL, PjBL, the inquiry and so on. Based on research that has been done by Hidayat (Lecturer STKIP Siliwangi Bandung) entitled "Meningkatkan kemampuan Berpikir Kritis dan Mahasiswa Kreatif Matematika SMA Melalui Pembelajaran Kooperatif Think-Talk-Write (TTW)", which states the results that the increased ability to think critically and creatively math students whose learning using cooperative learning Think-Talk-Write (TTW) is better than learning to use conventional methods (KONV) is based on the ability students of high, moderate, and less. Increasing students' critical thinking skills of mathematics derived from conventional learning and TTW in terms of the ability of students are high, medium and low. As for the students creative thinking abilities derived from TTW and KONV on aspects of high ability and are in high qualification [17]. Meanwhile, a second study conducted by Ade Rohayati, Jarnawi Afgani Dahlan, Nurjanah students Department of Mathematics Education FPMIPA of Indonesian Education University entitled "Improving the Ability of Thinking Critical, Creative, and Reflective High School Students Through Education Open-Ended" stating the results that the increased abilities creative thinking of students who get teaching problem solving mathematical (Open-Ended) better significantly compared with students who get expository [18]

V. CONCLUTION

Active learning is learning there since the time of Socrates. As stated by John Dewey that learning activities must be active, directly engage students, learner-centered (SCL = Student Centered Learning). There are several methods used in active learning is student-centered learning, self-regulated learning, collaborative learning, learning-to-learn, problem-based learning (PBL), project-based learning, inquiry-based learning. Then should educators in the era now using active learning in teaching because active learning can improve students critical and creative thinking that will be useful in facing era. Some studies have been conducted by education experts. The results of their research are active learning can improve students critical and creative mathematical thinking

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ME – 37

Metacognition Students In Problem Solving

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***Abstract*—**Metacognition is the mind's ability to monitor and control itself, in other words, the ability to know about our knowledge. In mathematics education, the importance of the investigation metacognition students during the mathematics activities that are focused on solving mathematics problems. This study describes the student metacognition in problem-solving Linear Equations System with 3 subjects the first semester students are capable of high, medium and low. By using the "think aloud", the results showed that subjects with high ability seemed to perform activities of metacognition at each stage in problem-solving Polya. Students with medium or lower did not do a good metacognition process in the last three stages of the problem-solving based on Polya step.

Keywords: *metacognition, problem solving, polya*

I. INTRODUCTION

The process of thinking in problem solving is an important thing that needs attention, especially teachers to help students to develop the ability to solve problems in the real-world context and in the context of mathematics. In order for this ability can be owned and developed, it needs the support of teachers, including giving students the opportunity to resolve the issue in its own way, as well as helping students to recognize and regulate their own thinking process when solving a mathematics problem. Process realize and organize the students' own thinking, known as metacognition, which includes thinking about how students make the approach to the problem, choose the strategies used to find solutions, and to ask ourselves about the problem (Gartman and Freiberg, 1993).

Metacognition is generally associated with two-dimensional thinking. The first is the awareness of a person about his thinking (self-awareness of cognition). The second is the ability to use awareness to adjust his thinking process (self-regulation of cognition) (Bruning et al., 1995). The second dimension of metacognition that has the properties of interdependence with each other. Woolfolk (1998) explains that metacognition refers to a way to raise awareness about thinking and learning is done. This awareness will materialize when one can start thinking with a plan (planning), monitoring (monitoring) and evaluation (evaluating) and the results of the cognitive activity. For the same thing, Lee and Baylor (2006) states that metacognition is awareness of the activity of cognition; in this case, metacognition relates to how a person aware of his thinking process. According to Flavell (1979), metacognition is defined as "cognition about cognition" or "thinking about thinking." He also explained that students who manage cognitive activities properly, allowing can handle tasks and solve problems well too.

Problem-solving according to Bailey (1989: 116) is a complex activity and a high level of mental processes. Solving the problem is defined as a combination of new ideas that emphasizes reasoning as the basis for combining ideas to problem-solving.

Arends (2007: 41) states that the learning model based problem is the model of learning by learning approach students on issues of authentic and meaningful to students who serve as the foundation for investment and the investigation of students, so that students can construct his own knowledge, foster a higher skill and inquiry, the student's independence, and improve self-confidence. This model is characterized by the use of real-life problems as something and improve critical thinking skills and problem solving, as well as gaining knowledge of important concepts. This learning model prioritizes the learning process where the teacher's task should focus on helping students achieve self-directed skills.

Some research indicates that metacognition plays an important role in solving problems. Research results Chamot et al. (1992) showed that students were able to absorb the lessons of mathematics at the highest level and obtain information about an exercise in strategy. metacognitive (ie planning, monitoring, and evaluation of learning itself) have better skills in problem-solving. Panaoura and Philippou (2004) shows a result of research that students who are skilled in knowing and regulate cognition and realizes its ability demonstrated ability to think more strategically in solving problems than those who are not aware of how the system works cognition. McLoughlin research results and Hollingworth (2003) showed that effective problem solving can be obtained by providing opportunities for students to apply metacognitive strategies when solving problems. Obviously, that between metacognition and problem solving has a fairly strong relationship.

Metacognition in this study is an overview of what it is about the students' metacognition which involves awareness and regulation of thinking in terms of planning (planning)thought processes, monitoring (monitoring) thinking process and evaluate (evaluation) process and the results of his thinking when solving mathematics problems by phasing Polya (1973).

The purpose of this study is to describe the student metacognition in problem solving of linear equations systems.

II. METHODOLOGY

This study is exploratory research that describes in depth profile of metacognition students of Department of Mathematics Tadris IAIN Tulungagung in solving mathematics problems. The data in this study are described qualitatively and the results in the form of written words, spoken or description of the subject of further research and analysis. Subjects were students of the first semester of academic year 2015/2016 IAIN Tulungagung do junior high school mathematics

Selection of research subjects with the following criteria: (1) is based on achievement test scores were done, the students are divided into three groups of ability, which is a subject capable of high, medium and low. The subject said highly capable, if obtaining a score of 85-100; subject capable of the medium, if obtaining a score of 65-84; and the subject of their low performance, if it obtained a score of 0-64. and (2) require consideration of whether the subject lecturer elected scored in accordance with the daily class capabilities and can express opinions verbally or in writing.

The data analysis consisted of three stages, namely data reduction, data presentation and interpretation or conclusion. Includes data reduction process to summarize, pick things that are basic, focusing on things that are important, look for themes and patterns. Presentation of data which presents the data is reduced so that the data is organized, arranged in a pattern of relations. Interpretation and conclusion of interpreting the data that has been presented later concluded.

Problem-solving test instruments are as follows

Problem 1: Three chickens large, medium and small weighed. If large and small, weighed 2.6 kg. If large and are being weighed 3 kg. And if that was small and weighed 2 kg. The third heavy chicken it was exclusively ...

Problem 2: Ali, Ani, Budi go to the store to buy pencils and books alike. Ali bought two pencils and two books, Ani buy three pencils and four books, while Budi buys a pencil and two books. If Ali and Ani consecutive pay Rp 2,500, - and Rp 4,500, - then Budi have to pay?.

III. RESULT

The data analysis was done for each phasing Polya (1973), the stage of understanding the problem, the stage of making plans Problem solving, the problem-solving phase of implementing the plan, and the stage to re-examine the results of problem-solving.

At this stage of understanding the problem, the students capable of high, medium or low in the first part, the core part and the latter part of the subject of metacognition activity.Subject matter carefully read and thoroughly showed that all three subjects to give attention to the information received so that information can be understood and remembered. After reading about the test, the three subjects to process the information shown on the response of the subject, which mentions things known and it asked of the matter and state the reasons underlying the answer. The process of calling back the information indicated by stating that the problem is a system of linear equations. Then the subject is also aware of the process and the results of monitoring the implementation of the current thinking in understanding the problem. This is indicated by the subject to think about prior knowledge is required, as well as proof of steps to be implemented even had planned to use the method to be used and has to think about the consequences of the choice of method to be used. In addition, subjects are aware of the process and the results of his thinking, in evaluating the measures, while understanding the problem. This is indicated by the subject to think about the choice of notation used and also think about the sufficient conditions that will be used for completion has been considered sufficient even the expected time to solve the problem is quite rational.

At this stage of thinking about plans problem solving, students are highly capable conscious in planning to say that after reading about the first thought is to imagine the use of elimination and substitution because you know: is the problem of linear equations 2 variables, but the student capable of analysis was low is still experiencing difficulties in determining the most appropriate way to resolve the matter. Subject highly capable aware of the process and results of thinking in developing the plan when thinking about a plan of action. It was shown at this stage subject to mention that in a short time has been able to plan a settlement, even related notions have been acquired and confident with what was planned. Then the subjects are aware of the process and the results of his thinking, in monitoring the implementation of the current thinking of a plan of action, as shown by the subject to remember that there are similarities with the problem earlier settlement ever doing that is a problem system of linear equations.

At this stage of implementing the action plan by selecting the completion strategy, highly capable students in the first part, the core part and the latter part of the subject of metacognition activity are good, but the student is not capable of being dang low. Subject highly capable aware of the process and results of thinking in developing the planning when implementing the action plan. This is indicated by the subject can easily solve the problem by using concepts, formulas or mathematics operations that have been previously understood, even a little suspicious with the smooth settlement can be a sign there is an error. Then the subjects are aware of the process and in monitoring the implementation of the results of his thinking at the time of carrying out a plan of action, this matter can be shown by the subject in detail explaining each step made. Likewise, the subject is also aware of the process and the results of his thinking in evaluating the action when implementing the action plan, which is indicated by the subject says confident 90% steps taken correctly, even feel no need to replace the measures taken, even the subject is also aware that there are steps unnecessary.

At the stage of evaluating and re-examine how best solution, highly capable students in the first part, the core part and the latter part of the subject of metacognition activity is good, but the student capable of analysis of medium and low no. Subject highly capable aware of the process and results of thinking in developing the plan at the time of evaluation. This is evident from his actions do check each step and looking back the answer. Then the subject is also aware of the process and the results of his thinking, in monitoring the implementation of the current evaluation. Subject unknowingly conducting well, even feel the answer is satisfactory and felt confident of being able to apply this method to other problems and although it has not had time to think of different ways, but be aware that the settlement is done is right. Likewise, the subject aware of the process and the results of his thinking in evaluating the action when performing evaluations. The subject was not necessary to the beginning because it is convinced the answer is correct.

IV. CONCLUTION

This study resulted in that at the stage of understanding the problem, the students capable of high, medium or low in the first part, the core part and the latter part of the subject of metacognition activity. Students with high ability seemed to perform activities at each stage of metacognition in problem-solving Polya. Students are capable of being, or lower did not do a good metacognition process in the last three stages of the settlement of the problem based on Polya step. Students with the moderate and low level of capability only look do metacognition at the stage of understanding the problem.

Finally, suggestions can be submitted in this research is student should always train in solving mathematics problems. In each stage of completion, the step should be trained metacognition process. The results could be used as one ingredient information to make more extensive research on metacognition students in solving mathematics problems with different characteristics and materials.

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ME – 38

Developing Mathematics Learning Material Based On CTL For Senior High School

Topic: Series and Sequence

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***Abstract*—** This research aims to produce mathematics learning material that consists of lesson plan and students worksheet based on Contextual Teaching and Learning (CTL) for grade X Senior High School and to describes the quality of the learning material that has been developed based on validity, practicability, and effectiveness aspects. The research type is development research with ADDIE model that consists of Analysis, Design, Development, Implementation, and Evaluation. The instruments that used in this research are assessment sheet of lesson plan, assessment sheet of student worksheet, student response questionnaire, and student achievement test. The results of this research are a lesson plan that used for three times learning process and a students worksheet with CTL approach on series and sequence for grade X Senior High School. In addition, based on the assessment of material expert, media expert, and mathematics teacher, the result of the research shows that learning material developed is very valid reviewed from lesson plan with an average score of 4.40 from maximal score 5 and student worksheet with an average score of 4.65 from maximal score 5. Based on the result of the student questionnaire responses, the learning material developed is very practical with an average score of 4.22 with maximal score 5. Meanwhile based on the students achievement test, the learning material is very effective used in learning activities as 83% of students who mastery the material.

Keywords: *learning material, CTL, series and sequence.*

I. INTRODUCTION

One of the specific objectives of learning mathematics in high school is that the learners (students) have a broad view and have respect for the usefulness of mathematics, critical thinking, logical, objective, creative, and innovative [1]. One of the efforts to achieve these goals is through the improvement of the curriculum. Today, Indonesia has been implemented Curriculum 2013.

Based on Permendikbud 2013 [2] about Basic Framework and Curriculum Structure SMA/ MA, mathematics in high school get into groups of mathematics compulsory and mathematics specialization. Group of compulsory subjects are part of general education is education for all citizens of the nation aims to provide knowledge, attitude as a nation, and the important ability to develop personal lives of learners, community, and nation. Meanwhile a group of subjects of specialization aims to provide opportunities for learners to develop an interest in a group of subjects according to the scientific interest in the college, and to develop their interest in a discipline or a particular skill.

According to the curriculum in 2013, has been set in Permendikbud 2014 [3] about Learning in Elementary Education and Secondary Education, which is to achieve quality learning, learning needs to implement several principles, namely: (1) students are facilitated to find out, (2) students learn from a variety of learning resources, (3) the process of learning to use a scientific approach, (4) competency-based learning, (5) integrated learning, (6) learning that emphasizes the divergent answers that have multi-dimensional truth, (7) learning based skills applicable, (8) an increase in the balance, continuity, and the relationship between the hard-skills and soft skills, (9) learning that promotes and empowering learners acculturation as a lifelong learner, (10) learning to apply the values to give exemplary (*ing ngarso sung tulodo*), build willingness (*ing madyo mangun karso*), and develop the creativity of learners in the learning process (*tut wuri handayani*), (11) learning that takes place at home, at school, and in the community, (12) use of information and communication technologies to improve the efficiency and effectiveness of learning, (13) the recognition of individual differences and cultural background of learners, and (14) fun and challenging learning environment. In addition, during the learning process, the learners are encouraged to find their own and transform complex information, check the new information with old information that already exists in memory, and developed them into new information or capabilities that suit with the environment and the time and place of their life.

Based on the above it can be seen that the learning of mathematics in high school based Curriculum 2013 not only aims to make the students understand and master the concepts, but also the learners able to apply these concepts into daily life problems.

Meanwhile based Permendikbud 2013 [4] concerning the standard of primary and secondary education, the learning plan need for learning material which includes the preparation of lesson plan and media and learning resources, assessment sheet, and learning scenarios. Lesson plan is arrangement of face-to-face learning activities for one or more meetings. Lesson plan was developed from the syllabus to guide the learning activities to achieve the Basic Competency (KD). One of the components that should exist in the lesson plan is a source of learning. This source of study can use books, print and electronic media, students worksheet, the environment, or other relevant learning resources. Thus to obtain the relevant learning resources, teachers are expected to develop teaching materials as a source of learning.

According to the observations in SMAN 1 Muntilan Magelang Regency and interviews with mathematics teachers, it is known that the learning activities undertaken lasted quite well, but learning resources used are still fixated on printed books provided by the Ministry of Education and Culture (Kemendikbud). In the learning process a lot of students are still using the old curriculum book presents only an instant formula without providing an opportunity for learners to construct their own understanding of a concept. This causes learners difficult to apply the concepts that they have learned in everyday life problems. During the learning activities take place many of the students who asked about the usefulness of mathematics in everyday life. Therefore, it is necessary to develop a learning material that can assist learners in linking the materials studied with the existing problems in daily life.

Nowadays, the role of the teacher in the learning process is no longer as a conduit of information, but as a facilitator for learners in learning activities. In learning mathematics, teachers should provide opportunity for learners to be actively involved so that the concept of the material being studied completely embedded and they know well. Learning mathematics will also be more meaningful if the learners are able to relate what they learn to the problems in daily life (Johnson) [5].

That is the background of the author to develop learning material such as lesson plans and students worksheet that can facilitate learners to construct their own knowledge. Based on interviews with mathematics teacher from SMAN 1 Muntilan Magelang Regency, learners are still difficulties in learning the material sequence and series. Therefore, the authors chose the material sequence and series to be poured into the students worksheets that will be developed with Contextual Teaching and Learning (CTL) approach.

The learning material with CTL approach can motivate learners to understand the material they learned by linking that material with the context of learner‘s daily life. Through CTL approach students not only memorizing formulas but also doing the understanding activity so that they can link the material with daily life problem.

According to Ditjen Dikdasmen [6] learning with CTL approach will help learners to construct their knowledge (constructivism), encourages learners to ask (questioning), facilitating learners to find the concept (inquiry), creating a learning community through discussion groups (learning community), presents a model in the process of learning (modeling), to assess the authentic assessment (authentic assessment), and habituate learners in the reflection of a sequence of learning activities that have been carried out (reflection). CTL approach not only helps learners to be able to relate what he had learned with everyday life, but also CTL approach helps learners to construct their own knowledge through discussion groups.

Development research of learning material with contextual approach had been done previously by Yudha Prihadi [7]. The results of the study entitled "Development of Mathematics Learning Material with Contextual Approach on Trigonometry for High School Grade X" indicates that the response of students towards learning mathematics with contextual approach included in the practical classification. It is shown the average total score of 80.73 with a maximum score of 100. The students worksheet is also effective to use in terms of the results of the learning achievement of students who achieve mastery percentage of 90% or satisfied the criteria very effective.

Based on problem above, the author considers the need for a development of learning material that consist of lesson plan and students worksheet with CTL approach on sequences and series to support learning activities. This development research entitled "Developing Learning Material with Contextual Teaching and Learning (CTL) Approach on Sequences and Series for High School Grade X".

The purpose of this study is to develop a mathematics learning material using CTL approach on sequence and series for Senior High School Grade X according to Curriculum of 2013. Good learning material satisfy validity criteria, practically criteria, and effectiveness criteria (Nieveen) [8]. The validity criteria ware based on the feasibility of the content, language, presentation, and graphics that defined in Permendikbud 2013 [9].

II. RESEARCH METHOD

This research was an development research to produce a mathematics learning material that consist of lesson plan and students worksheet. The research was carried out from 17 to 28 November 2014 in X IPA 2 SMAN 1 Muntilan Magelang Regency. The subject of this research was the students of X MIA 2 SMAN 1 Muntilan Magelang Regency 2014/2015.

The research procedures of this research was adapted development procedures of ADDIE model namely analysis, design, development, implementation, and evaluation (Wina Sanjaya) [10]. Analysis stage consisting need analysis, curriculum analysis, and learner analysis. Design stage consisting preliminary design of learning material (lesson plan and students worksheet) and validation of the assessment instruments of the product by expert lecturers. Development stage consisting product validation by a lecturer as a subject matter expert, a lecturer as a media expert, and mathematics teacher that the results will be used as a reference in revised the product. After the product was stated feasible to use, then product were tested in school. In addition, at the end of the product testing, students were asked to fill student responses questionnaire and do students achievement test. All the data that had been collected were analyzed by researcher. The last stage was evaluation. In this stage, researcher did the revision of learning material.

In this research, there were qualitative and quantitative data. Qualitative data consists of the comment and recommendation of validation by contain expert, media expert, and mathematics teacher. Quntitative data consists of the result of learning material validation, students responses questionnaire, and students achievement test.

Assessment sheet of the lesson plan arranged by several aspects such as identity, time alocation, indicators and learning objectives, learning material, learning approach, learning resourches, learning activity, and assessment. Assessment sheet of student worksheet arranged by the feasibility of contain, presentation, language, and graphics.

The instruments used in this research were assessment sheet of the lesson plan and assessment sheet of student worksheet to assess the validity, students responses questionnaires to assess the practically, and student achievement test to assess effectiveness.

The assessment sheets were given to material matter expert, media expert, and mathematics teacher. This assessment sheet and the student responses questionnaire were in the form of rating scale by five categories of assessment. The student achievement tests were designed based on the basic competencies and indicators that have been determined.

The data from this research was collected by observation, responses questionnaires, and test method. Responses questionnaires consists of assessment sheet of the learning material, students responses questionnaires.

The validity and practically of the developed product can be analyzed by several steps such as data tabulation, calculate the average score, and convert the average score into qualitative criteria based on Table 1 (Eko Putro Widyoko) [11].

Table 1. Conversion of Quantitative Data Into Qualitative Data

Interval score	Criteria
$X > \overline{X\iota} + 1{,}8\ SBi$	Very Good
$\overline{X\iota} + 0{,}6\ SBi < X \le \overline{X\iota} + 1{,}8\ SBi$	Good
$\overline{X\iota} - 0{,}6\ SBi < X \le \overline{X\iota} + 0{,}6\ SBi$	Enough
$\overline{X\iota} - 1{,}8\ SBi < X \le \overline{X\iota} - 0{,}6\ SBi$	Less Good
$X \le \overline{X\iota} - 1{,}8\ SBi$	Very Less

with,

$\overline{X\iota}$ = $\frac{1}{2}$(maximum score+minimum score)

SBi = $\frac{1}{6}$(maximum score-minimum score)

X = Average score

5 = Maximum score

1 = Minimum score

According to Table 1, it can be determined the interval of the assessment of learning material such as:

Table 2. The Interval of Validity Criteria of Lesson Plan and Students Worksheet

No	Score Interval	Category
1	$\bar{X} > 4,2$	Very Valid
2	$3,4 < \bar{X} \leq 4,2$	Valid
3	$2,6 < \bar{X} \leq 3,4$	Enough
4	$1,8 < \bar{X} \leq 2,6$	Less Valid
5	$\bar{X} \leq 1,8$	Very Less Valid

Table 3. The Interval of Practically Criteria of Learning Material

No	Score Interval	Category
1	$\bar{X} > 4,2$	Very Practical
2	$3,4 < \bar{X} \leq 4,2$	Practical
3	$2,6 < \bar{X} \leq 3,4$	Enough
4	$1,8 < \bar{X} \leq 2,6$	Less Practical
5	$\bar{X} \leq 1,8$	Very Less Practical

The learning material developed fulfills the validity and practically if it can achieve the minimum criteria are valid and practical.

To assess the effectiveness of the product developed can be complete by analyzing the outcome of student achievement test. The data can be analyzed by tabulated the results of students achievement test, make a percentage of the students mastery in a test, and then matched with the students mastery categories on the Table 4 (Eko Putro Widyoko) [11].

Table 4. Students Mastery Criteria

Interval	Criteria
$K > 80$	Very Effective
$60 < K \leq 80$	Effective
$40 < K \leq 60$	Enough
$20 < K \leq 40$	Less Effective
$K \leq 20$	Very Less Effective

with,
K= percentage of students mastery the material

The learning material satisfied the effectiveness when the minimum criteria were effective.

III. FINDING AND DISCUSSION

The product developed by ADDIE process in this research was a mathematics learning material consisting of a lesson plan that used for three times learning process and a students worksheet with CTL approach on sequence and series for grade X. Lesson plan was developed based on lesson plan format in Permendikbud 2013 [4]. While student worksheet was developed based on Depdiknas [1]. The quality of the product was assessed from three aspects of validity, practically, and effectiveness.

The validity of the learning material was assessed by the experts and mathematics teacher. The validity result of lesson plan was shown in Table 5.

Table 5. Validity Result of Lesson Plan

Aspect	Average	Criteria
Identity	4.67	Very Valid
Identity Compehensiveness	4.67	Very Valid
Time Allocation	4.33	Very Valid

Clarity learning objectives with KD	4.44	Very Valid
Compliance with the purpose of learning	4.33	Very Valid
Compliance with the learner's capabilities and needs	4.17	Valid
Suitability of the approach and methods of learning with the learning objectives	4.33	Very Valid
Suitability of the approach and methods of teaching to learners characteristics	4.33	Very Valid
Compliance with the standards process	4.49	Very Valid
Suitability of learning resources to the learning objectives and learner's characteristics	4.33	Very Valid
Conformity assessment techniques with the learning objective	4.33	Very Valid
Existence and clarity of assessment procedures	4.5	Very Valid
Average	4.40	Very Valid

According to the Table 5, it was given that the lesson plan reached the minimum criteria of valid in all aspects. Thus, based on the interval of validity criteria of lesson plan in Table 5, known that the lesson plan was resulted in very valid criteria with an average score of 4.40. Based on the result of validity was known that lesson plan that has been developed was appropriate with lesson plan format in Permendikbud 2013 [4].

While the validity result of students worksheet was shown in Table 6.

Table 6. Validity Result of Students Worksheet

Aspect	Average	Criteria
Contain	4.4	Very Valid
Presentation	4.6	Very Valid
Language	4.7	Very Valid
Graphics	4.9	Very Valid
Average	4.65	Very Valid

Based on Table 6, it was given that the student worksheet reached the minimum criteria of valid in all feasibility aspects. Thus, based on the interval of validity criteria of student worksheet in Table 2, known that the student worksheet was resulted in very valid criteria with an average score of 4.65. This indicated that students worksheet reached the feasibility aspect as regulated in Permendikbud [9].

Reviewing from the lesson plan and student worksheet, it can be conclude that mathematics learning material developed was very valid, had a strong theoretical framework, and consistency of relationship between each components.

The practically of mathematics learning material was known from the results of students responses questionnaire as the Table 7.

Table 7. Student Responses Questionnaire Results

Aspect	Average	Criteria
Usable	4.26	Very Practical
Contain Compehensiveness with CTL approach	4.30	Very Practical
Easiness	4.14	Practical
Attractiveness	4.16	Practical
Average	4.22	Very Practical

According to the Table 7, learning material reached the minimum criteria of practically in all aspects. Thus, based on the interval of practivally criteria of learning material in Table 3, known that the learning material was resulted in very practical criteria with an average score of 4.22.

While the effectiveness of learning material was assessed from the results of the students achievement test as shown in the Table 8.

Table 8. Student Achievement Test Results

Number of students	30
Number of mastery students	25
Percentage of mastery students	83%

Students achievement test consists of 5 item questions that have been verified by expert. This achievement test followed by 30 students and they have to finish the test in 90 minutes. According to the result of the test there are 25 students pass the minimal score (KKM). It means that 83% of the students mastery the material. So it can be said that the learning material developed was effective used in learning activities.

IV. CONCLUSION AND RECOMMENDATION

A. Conclusion

Development of mathematics learning materials that contain a lesson plan that used for three times learning process and a students worksheet with CTL approach on sequence and series for grade X was developed based on ADDIE procedure consisting of analysis, design, development, implementation, and evaluation. The quality of the product was assessed from three aspects; validity, practicality, and effectiveness. Based on the assessment of material expert, media expert, and mathematics teacher, the result of the research showed that learning material developed was very valid reviewed from lesson plan with an average score of 4.4 and student worksheet with an average score of 4.65. Based on the result of the student questionnaire responses, the learning material developed was very practical with an average score of 4.22. Based on the students achievement test, the learning material was effective used in learning activities as 83% of students who mastery the material.

B. Recommendation

In this research, the learning material that was developed from the kinds of criteria of validity, practically, and effectiveness reached in minimal good criteria, then it can be used either for students or teachers to support learning activity in sequence and series.

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ME – 39

Teachers' Perception Towards ICT in Mathematics Class: A case study in Yogyakarta Secondary Schools

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***Abstract** – Many countries have been integrating ICT in the classroom. Indonesia is heading towards integrating ICT in education. Teachers' perception is an important aspect to support the ICT integration. This paper presents the survey's results to fifty mathematics teachers in twenty Junior High Schools located in the rural area of Yogyakarta province. The survey reveals that most mathematics teachers participated in this study perceive that ICT has important role in mathematics class. They believe that ICT has positive impact on teaching and learning mathematics in the classroom. However, it is hard for some teachers to integrate ICT in the classroom due to a number of reasons such as technical barriers (computers availability, limited internet connection, electricity shortage, limited budget, and curriculum constrains) and human resources limitation (limited technology literacy both teachers and students, low teacher's motivation and little support from head-teacher). In addition, the teachers also point out another restrain that is students' readiness in using ICT for teaching and learning processes. The findings suggest that trainings for teachers in using ICT are needed and further efforts are required to encourage teachers to use ICT in the classroom. Furthermore, students' readiness needs to be assessed in the future research.*

***Keywords:** ICT, mathematics, teachers' perception*

I. INTRODUCTION

Nowadays, technology becomes an important part in daily life. It has been supporting education for a long time through the innovation in technology such as radio, tape-recorder, television, camera, computer, software and internet. Furthermore, it has been change the process of teaching and learning in the classroom, for example, the way teachers teach, the way students learn and the way schools are managed. Kessler [1] argues that ICT can enhance learning process in eight ways: 1) better simulations and models; 2) global learning; 3) virtual manipulatives; 4) probes and sensors; 5) more efficient assessment; 6) storytelling and multimedia; 7) E-books; and 8) epistemic games. The students can get learning materials easily from internet and explore the materials using many kinds of software that provided in the internet. They also can share and discuss the materials with others students. Consequently, teachers are not merely as sources of knowledge, but rather as facilitators and partners of students in learning processes.

The phenomena above also occur in the field of teaching and learning mathematics at schools. Previous research studies have been found that technology has many advantages in teaching and learning mathematics, for example: Burril [2], Ellington [3] and Olive and Makar [4]. In a simple way, technology can help students to deal with long and complicated calculations and complex models or complex problems. In a broader context, technology can change the nature of mathematics taught in the classroom by engaging students in more mathematical activities such as doing experiment, investigation and problem solving activities that can encourage them not only to find the answers but also to ask questions when solving mathematical problems [5, 6].

Indonesian government have been realizing the importance of ICT in education, therefore they suggest in the newest curriculum (curriculum 2013) that ICT should be integrated in teaching and learning processes in the classroom [7]. However, previous research studies that have been conducted in several parts of Indonesia found that there are many obstacles faced by teachers in integrating ICT in education. The common obstacles for teachers in integrating technology in teaching and learning processes in the classroom are lack of knowledge and skills, lack of technical supports, lack of facilities (e.g.: electricity, computer, software and internet access), insufficient incentive or rewards for teachers and insufficient training for teachers [8, 9].

Considering the importance of ICT in education particularly in teaching and learning mathematics, this paper investigates teachers' perception in using ICT in mathematics class. Perception is an important factor in implementing ICT in the classroom [2]. Perceptions could influence the willingness of the teachers in using technology in the classroom [10]. If they perceive ICT negatively, they tend to avoid using technology and vice versa. In addition, there are very limited studies on teachers' perceptions towards ICT that have been conducted in Indonesia. Therefore, this study tries to contribute on this issue by identifying perception of secondary school mathematics teachers in Yogyakarta, one city in Indonesia.

II. LITERATURE REVIEW

A. Teachers' Perceptions towards Integrating ICT in the Classroom

The perceptions of teachers toward using ICT in education system is a very complex phenomenon that includes receiving stimuli and information they get from their environment [11]. This process begins with cognitive process in the form of ideas, concepts and comprehension on the object they observe or they found [12]. Therefore, perception toward a certain object refers to responses towards opinion, ideas or situation that live in the memory and could affect their behavior. Other terms that are often used for a similar purpose with perceptions is views, opinion, and interpretation. This study focus on identifying teachers' perception towards integrating ICT in mathematics class. The perceptions in this study refers to the opinion of the teachers in using ICT in mathematics class. This includes their opinion related to the effectiveness, easiness and usefulness of technology in mathematics class.

The literature on teachers of mathematics has explored their beliefs on teaching and learning, their attitudes toward computers, and the obstacles they perceive in integrating technology. Early literature on this issue indicated that many teachers feared that using technology would harm students' understanding of basic math concepts, make them overly dependent on technology, and not be effective as an instructional tool [13, 14]. In addition, teachers indicated that they had not observed any software that really helped learning and using software did not save time in teaching or evaluation [15].

Literature also identified many factors influence the perceptions of teachers toward technology in teaching and learning processes. Teachers' educational beliefs about teaching and learning, about students, about pedagogy, and about the role of technology are several factors that strongly influence the ICT integration [16, 17]. The integration is not only influenced by internal factors of teachers, but is also influenced by environmental factors. For example, the support from head teachers and other teachers can affect teachers in integrating the ICT in the classroom. The availability of the gadget, curriculum, and support from supervisor and staff are the other factors that influence teachers' perception [18, 19].

In Indonesia, teachers seem to have similar obstacles as mentioned in the previous studies. Marwan [8] conducted a study in university, he found that lack of knowledge and skills, technical supports and incentive are main barriers for teachers in integrating technology in teaching and learning processes in the classroom. Moreover, Sumintono [9], in his study with science teachers, points out similar issues, limited teachers' skills, insufficient technology tools, and insufficient technical staff seems to be the most common problems in integrating technology in the classroom. There is no prior study, to the best known of the researchers, about secondary mathematics teachers' perception on technology usage hence this study aimed to fill this gap.

B. Technology Acceptance Model

There are many tools that have been developed to measure perception of technology usage. The technology acceptance model (TAM) is one of the most widely used models [20]. TAM was developed based on theory of reasoned action by Fishbein and Ajzen's [21]. This model was initially used as to measure user acceptance of computer technology. Several scholars claimed that TAM has good predictive power [22] which makes it easy to apply to different situations [10]. Thus, it is argued that TAM will also be useful in the predicting and explaining technology usage in Indonesia.

Empirical studies provide evidence that this model have high validity [23]. According to TAM, IT behaviors are mainly based on users perceptions of the easiness usefulness of the systems. Therefore, this model consists of two variables: perceived ease of use and perceived usefulness. Perceived ease of use refers to "the degree to which a person believes using a particular system would be free of effort" while perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" [24, p. 320]. The framework of the technology acceptance model is shown in Fig 1 below.

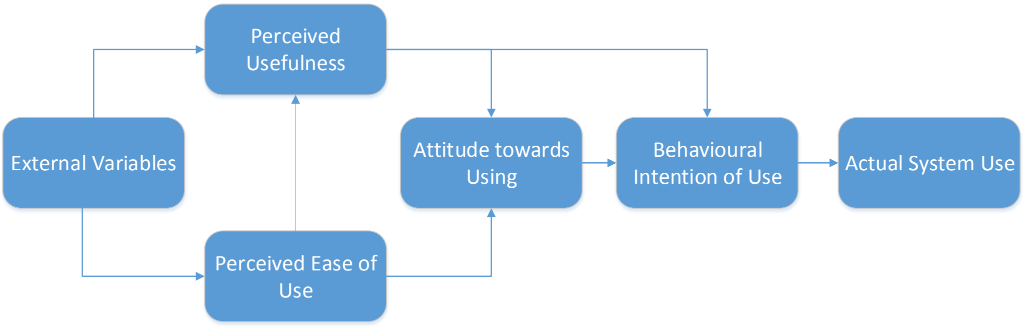

FIGURE 1. Technology Acceptance Model, adapted from [22]

The various studies conducted by researchers have tried to modify the TAM by adding new variables to it. For example, Agarwal and Prasad [25, 26] modified TAM by considering compatibility as a new variable. Moon and Kim [27] has added a new variable playfulness factors to study acceptance of the world wide web. Chau and Hu [28] combined the influence of peers with TAM.

The variables of TAM encompass the definition of perception of this study that mentioned in the previous section. Therefore, it is argued that TAM is an appropriate model for identifying teachers' perception for this study. This study modified the initial items of TAM to measure the perception of integrating ICT in education for mathematics teachers in secondary schools in Indonesia particularly in Yogyakarta. Sample of the measures and the variables are shown in table 1.

TABLE 1. Variabels and Sample Questions

Section	**Sample questions**
Perceived of Ease of Use	1. Using ICT in math class would be easy for me. 2. I would find it is easy to integrate ICT in mathematics class. 3. Using ICT in class requires much time to prepare. 4. Using ICT in mathematics class is confusing for my students. 5. It is difficult for me to use ICT in my mathematics class.
Perceived Usefulness	1. Using ICT allows me to increase my ability to teach mathematical concepts. 2. ICT would help me to illustrate the mathematical concept clearly. 3. Using ICT would enhance my effectiveness in teaching mathematics. 4. Using ICT would make mathematics more interesting for my students. 5. I cannot see any advantages of using ICT in my mathematics class.

III. METTHOD

A. *Participants*

The research particiants are fifty mathematics teachers in twenty Junior High Schools. These schools are located in the rural area of Yogyakarta province. The reasons for choosing schools in the rural areas is that there is limited access to the ICT. Therefore, we want know teachers' perceptions towards integrating ICT in education within that limitation.

The method of choosing the participants is voluntary and random sampling. All secondary mathematics teachers in all rural areas in Yogyakarta were invited to participate however only fifty of them are willing to participate.

B. *Instruments*

This research is a descriptive-qualitative research. The main tool of data collection is the questionnaire that elicits information on the respondents' views of the use of technology on the classroom. The questionnaire is developed based on TAM model, as discussed in the last part of literature review above. Data from questionnaire are enhanced by data gathered from interview with several teachers. Semi-structured interviews were used as the instrument for collecting data. Semi-structured interviews provide the researcher and participants with the opportunities to discuss some topics in considerable detail. In addition, the researcher can use cues or prompts to encourage the interviewee to consider the question further [29]. The questions asked in the interviews were meant to uncover information about teachers' perceptions and their intention to use ICT in mathematics class. It also used to gather obstacles, if any, in integrating ICT in the classroom.

C. Analysis

Data gathered from questionnaire are sorted and organized using SPSS. The data then analyzed descriptively including mean, modus, median of data. On the other hand, data collected from interview are analyzed using thematic analysis approach.

IV. Findings And Discussion

The aims of this study are 1) to determine Indonesian teachers' perceptions of applying technology in the classroom particularly in mathematics class; and 2) to identify the obstacles they may face in implementing technology. Based on these aims, the findings of this study are categorized under two main themes, namely: teachers' perceptions of integrating technology in the classroom and obstacles in applying technology in the classroom.

A. Teachers' Perceptions of Integrating Technology in Mathematics Class

The data of teachers' perceptions are mainly collected through survey questionnaire. The questionnaire consists of two parts. The first part of the questionnaire is aimed to portray demographic information of the participants such as gender, age, grade they teach in, and educational background. The characteristics of the participants are summarized in Table 2 below.

TABEL 2. CHARACTERISTICS OF THE PARTICIPANTS

Categories		#Participants	Percentage
Gender	Male	22	44%
	Female	28	56%
Age	Less than 30 year-old	11	22%
	30-50	36	72%
	More than 50 year-old	3	6%
Grade	VII	15	30%
	VIII	23	46%
	IX	12	24%
Educational Background	Undergraduate	46	92%
	Postgraduate	4	8%

The second part of the questionnaire contains 25 items that modified from the TAM scale. In general, data from the survey show that more than half of the number of participants perceive positively on the integrating of technology in mathematics class. Some of them are stay neutral, they unsure whether ICT would bring any positive or negative contribution in their teaching. Meanwhile, a small number of teachers who believe that the integration of ICT in education is not urgent things to do because they and their students are not ready with the changes yet. The summary of the questionnaire data can be seen in Table 3.

TABLE 3. Data from Questionnaire

Category		Perception		
		Positive	Neutral	Negative
Gender	Male	81.82%	9.09%	9.09%
	Female	53.57%	28.57%	17.86%
Age	Less than 30 years old	90.91%	9.09%	0
	30-50	61.11%	22.22%	16.67%
	More than 50 years old	33.33%	33.33%	33.33%
Grade	VII	80%	13.13%	6.67%
	VIII	69.56%	21.74%	8.70%
	IX	41.67%	25%	33.33%
Educational background	Undergraduate	63.04%	21.74%	15.22%
	Postgraduate	100%	0	0

Taking into account gender differences, data in Table 3 show that most of the male teachers have positive perception of the integration of ICT in education. Meanwhile, only slightly more than half of the female teachers have positive perception, and more than a quarter are neutral. The interviews reveal that those who have positive perception, they believe that ICT would be beneficial for both teachers and students. For example, ICT could provide interactive media and good illustrations so that it would help students in mastering mathematical concepts.

Another interesting data in Table 3 is that teachers who have positive perception are young teachers (less than 30 years old) and those who hold postgraduate degree. The young mathematics teachers claim that ICT has many advantages in teaching and learning mathematics. Similarly, teachers who have postgraduate degree also claim the power of ICT in mathematics class as their main reasons in having positive perceptions.

In relation to the grade, teachers grade VII tend to have more positive perception compare to their counterpart in grade VIII and IX. From the interviews with some grade VIII and IX teachers, they tend to hold negative perception with the integration due to the difficulties in adjusting with the recent curriculum. Grade IX teachers also express their worrying about the integration of ICT that might distract the preparation of the students for national examination.

In summary, the findings have revealed that the majority of participants are aware of the benefits of teaching with technology. They believe that the integration of technology into the classroom can enhance their teaching quality. This can be a good indication of successful implementation of the technology integration program if teachers know about the benefits of technology for teaching and make frequent use of it in their instructional activities [30]. Nevertheless, the teachers also notice several challenges in integrating ICT in education as discussed in the next section below.

B. Obstacles in Applying Technology in the Classroom

The interviews are aimed mainly to identify challenges faced by mathematics teachers in integrating ICT in the classroom. Most of the teachers claim that their technology literacy the main challenges for integrating ICT in mathematics class. They can cope with the rapid development of technology, as represented in the teacher' statement below:

> *Kami itu punya banyak sekali kerjaan, Bu. Ya tentang administrasi seperti membuat rpp, dan juga LKS. Kan sekarang setiap sekolah dituntut untuk membuat LKS sendiri. Jadi kadang tidak ada waktu untuk belajar tentang bagaimana menggunakan alat-alat teknologi yang semakin canggih. Begitu juga dengan software-software mathematika banyak sekali yang baru-baru. Yang lama saja saya belum bias, sekarang ada lagi yang baru. Kadang saya malah bingung dan pusing sendiri hahaha*

From the statement above, teacher argues that he has many administrative matter to do as a teacher and he does not have enough time to follow the technology development. In more specific, he refers to the development of mathematics software, he claims that he has not even finish to learn how to operate one mathematics software yet, but there is more new mathematics software to come. In relation to this, many teachers looking for some assistance from the government to conduct workshops or training for teachers so that they can upgrade their skills in ICT. Moreover, they questioning the technology skills of their students. They claim that many of their students have limited skills, some of them in the rural area even do not have any gadget. Thus, training in technology is an important ingredient in order to integrated technology in the classrooms effectively, as suggested by [31].

Several teachers also mention the technical barriers, for example insufficient number of computers availability at their schools, limited internet connection, electricity shortage, and limited budget. Grade IX teachers also point out that the density of the current curriculum as one of the constrains in using ICT in mathematics class. They argue that they have to deliver so many mathematical concepts in limited length of time, so they worried if the use of ICT would prevent them to finish the material they have to deliver. In addition, the issue of national examination seems to be one of the biggest constrain for mathematics teachers grade IX.

The other challenges found in the interview data are limited human resources who master in ICT to support the integration. In addition, the teachers also mention another restrain that is support from head-teachers. They claim the importance of leader's support. This is in line with the findings of study conducted by Puteh and Vicziany [32]. Diem [33] argues that "teachers who are supported are less likely to feel threatened and develop more positive attitudes toward technology" (p. 495).

V. CONCLUSION

Most of mathematics teachers in this study have positive perception in using ICT in mathematics class. This study also notices that ICT integration in mathematics class face many challenges yet it is possible to do. However, it is important to note at this point that this study involved a small number of teachers in one district. Therefore, the results might not necessarily to represent teachers' perceptions and challenges in technology integration at other part of Indonesia. Some findings may be useful for future research or as a starting point for planning technology integration in schools.

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ME – 40

Ethnomathematics in Marriage Tradition in Adonara Island-East Flores

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Abstract - This paper describes the mathematical knowledges of Adonara society in the marriage tradition known as ethnomathematics. Collecting data were conducted using unstructured interviews and documentation. Interviews were conducted with several informants selected based on the consideration of researcher and suggestion by previous informant. Documentation was done using video recordings and photos. The data were analyzed refers to the characteristics of ethnomathematics that include: *Counting, Locating, Measuring, Play, Designing and Explaining* - CLMPDE. Result shows that there are a number of mathematical knowledges in the marriage tradition in Adonara island called as ethnomathematics such as: counting, measuring, estimating, comparing, sorting, and various geometry concepts. These is found in all process from giving dowry until custom party.

Keywords: *counting, dowry, ethnomathematics, marriage, measuring*

I. INTRODUCTION

One of the students' capitals brought to school is the cultural capital. Teachers should develop learning mathematics based on the student cultural capital to motivate and arouse students' interest in learning mathematics. The use of student' culture as an illustration of concept of mathematics is expected to help students understand the concepts being studied. Exploration charge a mathematical concept in view of culture to foster knowledge and awareness of students that they can contribute to the discoveries of mathematics, because mathematics is not the dominance of a particular culture. Besides, the student culture can be used as context and learning problems in learning the appropriate mathematics concepts. Teachers in teaching mathematics is expected to utilize culture as a context, the media, and also as a learning resources.

But the facts show that the mathematics learning in schools may not use culture as a context of learning. Mathematics learning just focus on textbooks rather than use what was available in the neighborhood including an cultural environment. Cultural environment that involved educational value is not used as a media and learning resources. Teachers are stuck on the notion that learning media and learning resources should be purchased or only from teachers and textbooks. Teachers have difficulty associating specific mathematical concepts with appropriate cultural context. Even teachers are not aware that in the cultural activities contained various mathematical concepts.

Mathematics as a social-culture construction where mathematics is contained in history and in human activity, so it is said that mathematics is a human activity, either already or not yet published ([1] Ernest, 1993, [2] Freudenthal, 2002; [3] Romberg, 2004; [4] Mukhopadhyay and Greer, 2011). It means that the human activities directly or indirectly related to mathematics.

The above description indicates that there are various mathematical knowledge called as ethnomathematics in the marriage tradition in Adonara society. It is based on the fact that the marriage tradition is one of the Adonara community's culture inherited the previous generation and still maintained to the present time. Indepth study was needed to reveal and describe ethnomathematics or mathematical knowledges in the marriage culture of Adonara society and create a mapping concept to show the relationship between ehtnomathematics and school mathematics so that it can become a reference for teachers in developing teaching materials and based-culture learning.

II. LITERATUR REVIEW

A. Mathematics and Culture

Mathematics and culture are related each others. Mathematics on the one hand shaped by culture and mathematics on the other hand is used as a tool for the advancement of culture. In other words, mathematics is not free from the culture but the mathematics as a part of the culture and as a form of human culture.

Mathematics is a socio-cultural construction in which mathematics is contained in history and in human activities. Thus mathematics can not be separated from the humanities and social sciences, or from what is expressed as human culture in general, so it is influenced by the values of humanity as well as other fields of knowledge ([1] Ernest, 1993). Knowingly or not that a lot of human daily activity is always associated with mathematics, so it is said that mathematics is a *human activity,* either already or not yet published ([2] Freudenthal, 2002; [3] Romberg, 2004; [4] Mukhopadhyay and Greer, 2011).

Mathematics as we know is a phenomenon tied to the culture, and every culture has created ideas where clearly labeled as "other mathematics". Also mathematics is a cultural phenomenon, and mathematics as a *pan-human activity* ([5] Bishop, 1988; [6] Dowling, 1998). Furthermore, mathematics (mathematical knowledge) already exists in every culture, embodied in each culture, which, as a " frozen mathematics" ([7] Gerdes, 1997; [6] Dowling, 1998). Mukhopadhyay and Greer defines mathematics embedded in all cultures, much of mathematics as an academic discipline. Raju said that mathematics is a cultural formation, influenced by special philosophy culturally ([4] Mukhopadhyay and Greer (2011). Also Milroy said that all cultures develop their own mathematical forms depending on the needs of their neighborhoods and communities of interest ([8] Milroy, 1992).

Mathematics is a cultural phenomenon, present in every culture, embedded in culture, shaped by every culture, influenced by the culture, and has its own form in accordance with the needs of environmental and community objectives ([9] Dominikus, 2014). This means any different cultures will have different mathematics. In particular it can be said that there is any ***hidden mathematics*** in the Adonara culture while Adonara people never say that they have the mathematics ([10] Dominikus, 2015). In general mathematics in culture is known as ethnomathematics.

B. Ethnomathematics

The meaning of ethnomathematics always change and evolve since it was first introduced by D'Ambrosio in the early 1980s to the present time. The changes associated with cultural significance or cultural groups into ethnomathematics research areas, from ethnomathematics as a research subject heading ethnomathematics as a field of research. It appears in a variety of senses of ethnomathematics as described in this section.

Initially, ethnomathematics related to mathematics practice of illiterate people, and mathematics practice in a culture without written expression of a society which is seen as a primitive society ([11] Ascher, 1997: 26; [12] D'Ambrosio, 1997: xv;). Here Ascher and D'Ambrosio emphasized that the focus ethnomathematics limited to cultural communities that are less or never learned school mathematics.

Further, ethnomathematics referred to a form of mathematics or mathematics contained in the cultural activities of various cultural groups such as ethnic communities, labor groups, children of certain age groups, professional groups, and others ([13] Nunes, 1992; [12] D'Ambrosio, 1997: 16). Milroy (1992) put ethnomathematics deals with the study of different types of mathematics that arise or exist in a variety of cultural groups. Furthermore ethnomathematics relates to a form of cultural knowledge or characteristics of the social activities of a social group or culture, which can be recognized other groups such as west anthropologist , but not necessarily known by the origin, as knowledge of mathematics or mathematical activity ([14] Presmeg, 2007: 440). Mathematical knowledge of a cultural group may be known in the jargon, symbols, myths, and in certain ways people use for calculating, concluding, sorting, and grouping ([15] François, 2012: 1; [16] Meaney, 2008: 52). Previous meanings of ethnomathematics illustrate that ethnomathematics related to mathematics or mathematical practice or mathematical knowledge or mathematical activity in the cultural activities of a particular cultural group. It can be said that we can find a variety of mathematical practice or mathematical knowledge in a certain community groups that can then be said as ethnomathematics.

Currently, ethnomathematics has become the field of research on mathematics in culture ([17] Gerdes, 2014), the relationship between culture and mathematics ([18] Barton, 1996; [19] Alangui, 2006), and the role and influence of ethnomathematics in mathematics and mathematics education ([20] Begg, 2006: 1; [21] D 'Ambrosio, 2001: 1, [22] D 'Ambrosio, 2001: 1; [23] Horsthemke, 2006: 4). In this context, ethnomathematics will enrich mathematics that are commonly known and learned in formal educational institutions during the time and will also affect the mathematics education.

This study describes the practice of mathematics or mathematical knowledge of Adonara society in the marriage tradition. The results of this research can be used as a reference in developing culture-based mathematics learning.

III. RESEARCH METHOD

This research is a qualitative descriptive study with the aim to describe the mathematical knowledge of Adonara society in the marriage tradition. Data were collected with unstructured interview and documentation methods. Interviews were conducted to 5 people custom figure as a subject of study with all aged over 60 years. The data collected related to dowry agreement and its return, giving dowry, and traditional wedding party. Selection of the number of research subjects at the top as well as to ensure the validity of research data. Analysis of data using interactive methods Miles and Huberman which consists of reducing the data, presenting data, and making inferences ([24] Sugiyono, 2007). Data was analyzed descriptively with reference to the characteristics of ethnomathematics comprising: *counting, locating, measuring, play, designing,*and *explaining* ([5] Bishop: 1988).

IV. RESULTS AND DISCUSSION

The marriage for Adonara people be understood not only unite a man and a woman who later became husband and wife, but also unite families on both sides. The mating process consists of a series of rituals associated with the provision of a dowry (bride price) or *welin* and other processes before and after giving dowry. The dowry of Adonara women is ivory together with goats and pigs within a certain amount as a pair of ivory. Replies should be given the woman's family in the form of woven fabric *(kewatek)* and shirts by an amount deemed feasible and commensurate with ivory and how many goats and pigs received.

The highlight of the mating process is to strengthen marriage by a religious institution. In Adonara society the dowry is not an absolute requirement to obtain confirmation of marriage by religious institutions. Giving dowry be implemented before marriage or after marriage in a religious suspended depending on the chosen form of marriage and the agreement of both families. There are several activities that illustrate mathematical knowledges in the marriage tradition as described below.

A. Counting

Counting activities in the marriage tradition found in counting the number of animals as a pair of ivory that would be handed over to the family of the boy female family. It also calculates the number of woven fabrics *(kewatek)* and shirts in reply by the woman's family to the men’s family. Counting Activities also performed to determine the number of animals to be cut and the number of participants plate in custom party. All of these will be described below.

The number of animals as a pair of ivory is usually odd. If the number of animals are 3 that it consists of two goats and one pig. If the number of animals are 7 then at least two pigs and five goats. Usually the number of pigs are less than goats. No matter how many pigs were given to men’s family and women’s family will be cut out for the traditional feast. Otherwise not all goats are cut. Goat called as *bala talin* to be maintained.

When given animal as a pair of ivory is 7 animals consisting of 2 pigs and 5 goats, then in the Lamaholot language expressed as follows, w*awe rua **noon** Witi lema ke ewan **mupune** pito* (2 pigs with five goats so the total animals is 7). It can be written in mathematical sentence as follows: **2 pigs + 5 goats = 7 animals.** In this contex, addition process is done for two subset (pig and goat) from the same set (animal). It shows that concepts of set and subset are hidden within the marriage tradition.

Similarly, in calculating the woven cloth and shirts in retaliation for ivory and animals that have been received. Usually woven fabric *(kewatek)* wrapped in another cloth called *kenabu.* The number of woven fabric *(kewatek)* in each bundle *(kenabu)* between 50-80 pieces. If at the time of the conducting brought 4 packs of woven fabric and 2 packs of shirt then the total is six packs of fabric. In the Lamaholot language spoken in the following, *kewatek kenabu paat **noon** labu kenabu rua **mupune** ale kenabu neme* (4 packs of woven fabric with 2 packs of shirt so altogether there are 6 packs of fabric). The corresponding mathematical sentence can be written as follows, **4 packs of woven fabric + 2 packs of shirt = 6 packs of fabric.** In this contex, addition process is done for two subset (woven fabric and shirt fabric) from the same set (fabric). It shows that concepts of set and subset are hidden within the marriage tradition.

Both of the above illustrates that the addition operation performed by summing the numbers that appear regardless of the attributes associated with that number. It shows that concepts of set and subset are hidden within the marriage tradition. Here counting process or action taken is *pupu* (collect) and the outcome of its actions are *mupune (overall).*

At the time of giving woven fabric and shirts to men's families , if the mother of the girls also come together then when the group back home should be given another three goats. This goat is called *ina umene* or *Witi dese bola'.* If when giving ivory time has brought five goats, then the number of goats were given by men's family entirely 8 tails. In the language of Lamaholot expressed as follows, *Witi lema tali' Witi Telo mu* ***mupune*** *witi Buto* (five goats plus three goats more then totally 8 goats). It can be written in the form of the following mathematical sentence, **5 goats + 3 goats = 8 goats.**

Similarly, if initially brought the number of woven fabric there are 4 packs, but by men's family deemed it is not enough then through good communication between two families, the families of women will add it again. Suppose it is delivered again 2 packs of woven fabric, then the total number is 6 packs of woven fabric. In the language of Lamaholot expressed as follows, *kewatek kenabu Paat* ***tali*** *kenabu rua mu* ***mupune*** *kenabu neme* (four packs of woven plus two packs more so altogether become 6 packs of woven fabric). Corresponding mathematics sentence is, **4 packs of woven fabric + 2 packs of woven fabric = 6 packs of woven fabric.**

The last two mathematics sentences illustrate the process of adding two same set. The addition process is accordance with the usual procedure. In the context of this action to add so-called ***tali*** (add more) and the result of the actions referred to ***mupune*** (overall)). It can be said that in everyday life of Adonara people known 2 activity associated with the arithmetic operation of addition in which the action ***pupu*** and ***tali.*** *Pupu* and ***tali*** actions are often found in other activities of custom party.

The number of animals to be cut firstly discussed by family taking into account the number of animals donated to families of men and the number of woven fabric (*kewatek*) donated to the family of women. Subsequently converted into the number of plate as allotments for each contributor to both animal and *kewatek*. Usually one animal was allotted 15 dishes and one sheet of woven fabric or shirt armor allotted 10 plates. Moreover calculated the number of boy of another family were invited to follow the traditional feast.

After a number of dishes entirely known, discussed hereinafter also how many pieces of meat eligible for each plate. Generally, three pieces of meat on each plate is said to have good *(kererhan me'la),* and more than 3 that is 4 or 5 pieces of it have been the best once *(kerehna mela'-mela ').* With the helping of certain commonly estimated the size of the animal and the amount of meat, then it is certain how many animals will be cut.

Counting the number of animals raised in the family of the boy known that a total of 40 animals (goats and pigs), then the number plate of a total of 600 plates. From the calculation of the boys family are invited to know the number of plate is 150 then the traditional party that there will be 750 dishes. Taking into account the remaining animals for traditional party, it was agreed each dish to share as much as 5 pieces of meat. 1 piece of meat the size of approximately 5 cm x 5 cm x thick meat based meat posture itself (about 3-5 cm). A big pig was estimated to be up for 150 plates, and for a big goat was estimated to be up for 60 plates, then for the traditional feast that will cut the animal at least 7 animals consisting of 4 pigs and 3 goats.

In this process found their arithmetic operations as addition, subtraction, multiplication, and division. The number of dishes that in line with the number of animals can be obtained from the summing 15 as much as 40 times or in the form of multiplication written **40 x 15 = 600.** The total plate in a traditional feast was derived from the number plate in accordance with the number of animals and the number of plate in accordance with the number of boys invited then **600 plates + 150 plates = 750 plates .**

Related to the number of pigs and goats to be cut, it was calculated as follows, 1 pig for 150 plates, then two pigs for 300 plates. If the two times of the pig is 4 then it can be for 600 plates. The rest of the plate is 150 so it can be cut three goats. Here it is understood that the three goats for 180 plates so that it can meet even exceed 150 dishes were leftovers. It can be written as:

1 pigs for 150 plates
2 pigs = (1 + 1) pigs for (150 +150) = 300 plate
4 = (2x2) pigs for (2 x 300) = 600 plate
The rest of the plate = 750-600 = 150
1 goats for 60 plates, then 150-60 - 60 = 30, then the goat could be cut as much as three.

From the mathematical sentence as described above, it is clear that there are some arithmetic operations such as addition, subtraction, multiplication, and division.

B. Measuring

Activities associated with measuring especially the length and the large of ivory. The length of ivory measured by fathoms, while large of ivory measured by the great circle formed by the left and right hand span. Measuring instruments used is not a standard measuring tool but uses a part of the body length and span fathoms.

There are three types of length ivory, those are longer than one fathom, ivory length exactly one fathom, and ivory that is less than one fathom. Here, the unit of measurement is the length of fathoms. The Large of ivory can be classified into three groups, namely the ivory more than one circle formed by the left and right span, the ivory magnitude of exactly one circle formed by left and right span, and the ivory is less than one circle formed by the left and right span. Here, the unit of measurement is the length of the span.

The length of ivory is measured by a spokesman or *pehen koda.* By the length, there are some names of ivory in Lamaholot language as follows.

1. *Bala Raine:* ivory length more than one fathom, (1 fathom = length of the tip of right forefinger to the tip of forefinger of the left hand).
2. *Bala Huut:* ivory length exactly one fathom.
3. *Bala Urat Tukan:* ivory length from the tip of right forefinger into the middle of the palm of left hand.
4. *Bala Beeda' Wua':* ivory-length from the tip of right forefinger into the middle part between the wrist and the middle of the palm of left hand.
5. *Bala Meke Nile / Hayon taa ':* ivory-length from the tip of the forefinger right hand to the left wrist.
6. *Bala Kala U 'lin:* ivory length of the forefinger right hand to the left hand in the right place to have a bracelet or a watch.
7. *Bala Kala keteka:* Ivory length of the forefinger right hand to the left hand is approximately 10 cm from the left elbow to the wrist.
8. *Bala sue lodon:* ivory length of the the forefinger right hand to the left hand approximately 5 cm from the left elbow to the wrist or the left elbow and *kala keteke.*
9. *Bala Leku:* ivory length of the forefinger right hand to the left elbow.
10. *Bala Sue:* ivory length from the tip of the right forefinger to the left arm approximately 10 cm above the left elbow
11. *Bala Soru Nabit:* ivory length from the tip of the right forefinger into the base of the left arm.
12. *Bala Tuho Tukan/korok :* ivory length of the right forefinger to the left breast.
13. *Bala Lega korok:* Ivory length from the tip of the right forefinger to mid-chest.
14. *Bala Lima Papa / kepali papa:* ivory length along one arm.

Based on the large of ivory, it is known that some types of ivory size in Lamaholot language known as:

1. *Higi' telo:* ivory size of one circle formed by the left and right hand span plus three fingers ie index finger, middle finger, and ring finger.
2. *Higi' rua:* ivory size of one circle formed by the left and right hand span plus two fingers, namely the index finger and middle finger.
3. *Higi ' kuluk:* ivory size of one circle formed by the left and right hand span plus index finger.
4. *Suda ':* ivory magnitude of exactly one circle formed by the left and right hand span.
5. *Pesok raru:* ivory magnitude of the circle formed by the thumb and the top segment of the index finger of the left and right hand.
6. *Pesok raru rua:* ivory magnitude of the circle formed by the thumb and middle segment of index finger of the left and right hand.
7. *Darap lema:* ivory magnitude of the width of 5 fingers.
8. *Darap Paat:* ivory magnitude of the width of four fingers.

C. Comparing and Sorting

By measuring the length and large of ivory as described previously, there is comparing activity. The length and the large of ivory are determined according to the name in accordance with the measurement results based on the length of fathoms. In general, the length is divided into three namely ivory that are more than one fathom *(bala raine),* exactly one fathom *(bala huut),* and less than one fathom (ranging from *bala urat tukan to bala kepali papa).*

Likewise with the large and the small ivory is determined in accordance with its name after measured by the great of circle formed by the left and right hand span. In general, the large of ivory is distinguished on 3 ivory namely the large of more than one circle formed by the left and right hand spans *(Higi'),* exactly one circle *(suda'),* and less than one circle *(pesok).*

Another activity that follows the measurement results is the sorting activity. Giving the name of the appropriate length of ivory sequentially ranging from the longest to the shortest ivory or otherwise. Similarly, the naming of ivory corresponding to the large or magnitude in the order from the biggest to the smallest ivory or vice versa.

V. CONCLUTION

From the above description it can be concluded: *first,* although the Adonara do not have any words to mathematics in their lives, but they have a variety of mathematical knowledge used in the whole process of marriage such as counting, measuring, comparing, estimating, and sorting, which refers to the characteristics of ethnomathematics (Bishop: 1988) all of the above is a mathematical knowledge in the mating process, known as **ethnomathematics in the marriage tradition.** *Second,* in the marriage tradition there are also arithmetic operations such as addition, substraction, multiplication, and division. Related to the addition operations there are two action or activity *pupu* (add up of 2 different subsets) and *tali'* (add up of 2 same subsets). *Third*, the used measuring devices are not standard form those are the length of fathoms and hand span. The measurement results such as the length and the large of ivory are not expressed in numbers quantitatively.

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Abstraction Measurement of Students in Constructing Proof Algebra Problems

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Abstract**—**This study aimed to describe the abstraction of measurement of students in constructing the proof of algebra problems. For this purpose, a qualitative explorative research with task-based interview techniques was conducted. The subjects were the students of math education, class of 2013, UNIROW Tuban. Students who became the subject of research has taken a course of Algebra Structure. Measurement of abstraction used RBC models (Recognizing, Building-with, Constructing). Recognizing refers to the fact, the basic concept which has already known. Building-with refers to the combination of facts or concepts into a new context, and Constructing refers to the ability to build a proof of statement/issue based on facts or concepts to show that the statement is true. The main instrument was the researchers themselves, and the supporting instrument was interview guides that referred to the RBC model. Data were analyzed qualitatively. Conclusions were obtained based on the analysis results, those were: Recognizing, students tended to be able to know a few facts, concepts that supported the evidentiary issues, example: the closed nature, associative, neutral element, inverse of element, grupoid, semigrup, group. Building-with, students tended to be able to combine the concept of the closed nature, associative, neutral element, inverse of element, grupoid, semigrup into new contexts that were interrelated. Constructing, students in constructing proof algebra problems, there were still many steps that were illogical in the use of facts or concepts. Consequently, the proof tended to be incorrect, although conclusion was ultimately correct.

Keywords: *abstraction, recognize, building-with, construct, and proof.*

I. INTRODUCTION

Abstraction is a process that is fundamental both in mathematics and mathematics education. Abstraction has been known as something that important role for successful learning of mathematics when viewed from the standpoint of cognitive. However, abstraction is also one of the main reasons of the failure of the process of learning mathematics [1]. Reference [2] the term abstraction is used for both the process and results. To differentiate the two, used the term abstraction process on the one hand, and the entity that generated on the other side. Abstraction is an activity (in the sense of activity theory), a chain of actions undertaken by an individual or a group and driven by a motive that is specific to a context. Abstraction is an activity of vertically recognizing previously constructed mathematics into a new mathematical structure [2].

Abstraction in mathematics is a process for obtaining the essence of mathematics concepts, eliminating dependence on the properties owned by the object and made more general so that it has applied a broader or corresponded with other abstract explanations for similar symptoms. One characteristic of mathematics is to have an abstract object. Abstract concepts in mathematics can be learned through the process of empirical abstraction and through a mathematical abstraction. The abstraction process takes place through a series of learning activities that involve various aspects of learning. Abstraction process is a process of contextualization, because it does not pay attention to the object as well as the characteristics and relationships that are owned. This process is linear, originated from the objects to the class or a structure called the object at a higher stage [2]. Abstract regarded as intrinsic properties of the new object and the importance of context in the process of abstraction.

In broad outline, the abstract can be divided into empirical and theoretical abstraction [3]. In the process of empirical abstraction, the formation of the notion of an abstract object that is based on empirical experience. Both processes are based on the abstractions of social and physical experience of the child. The abstraction empiric focus on the process of identifying important displays are common, then the concepts generated from the empirical abstraction process is also called abstract-general [3]. The idea of the theoretical abstraction stems from two psychologists from the Soviet namely Vygotsky and Davydov. Theoretical abstraction consists of forming concepts to be adjusted to some theories. Vygotsky makes a difference in the meaning of the concept in the context of everyday life with the concept in the context of scientific fields. According to Vygotsky, the concept in the context of everyday life in the form through the process of empiric abstraction. While the formation of scientific concepts consists of three aspects, namely; (a) the establishment of a system of various relationships between concepts, (b) an awareness of the mental activity of a person, and (c) penetration into an essence of the object it will enrich the reality presented in the concept, not vice versa [3].

To perform an abstraction, a person requires logic. Davydov [2] proposes that the origin of events abstraction, namely abstraction starts an initial, simple, undeveloped first form, which need not be internally and externally consistent. The development of abstraction proceeds from analysis, at the initial stage of the abstraction, to synthesis. It ends with a consistent and elaborate final form. It does not lead from concrete to abstract but from an undeveloped to a developed form of the abstract in which new feature of the concrete are emphasized. Reference [4] in processes of abstraction, the epistemic actions are nested. C-actions depend on R- and B-actions; the R- and B-actions are the building blocks of the C-action; at the same time, the C-action is more than the collection of all R- and B-actions that make up the C-action, in the same sense as the whole is more than the sum of its parts. The C-action draws its power from the mathematical connections, which link these building blocks and make them into a single whole unity. It is in this sense that we say that R- and B-actions are constitutive of and nested in the C-action. Similarly, R-actions are nested within B-actions since building-with a previous constructs necessitates recognising this construct, at least implicitly. If the students solve a standard problem, they are likely to recognize and buildwith previously acquired structures. If they solve a non-standard problem, they might get in the process of construction [2].

The problem in mathematics by [5] is divided into two, namely: the problem of determining and evidentiary problems. Further Polya said that "the problem of determining" the more important in basic math, while the "problem of proving" more important in advanced mathematics. Reasoning and thinking logically be authorized to resolve the problem of proof. [5] says that the purpose of proving the problem is to clearly indicate that a statement is true or not. This is to answer the question: is this statement true or false? In line with this, Rav [6] states that the evidence is the way a mathematician to display mathematical tools to solve problems and to justify that the proposed settlement of the problem is the solution. This means that the evidence may help to understand the meaning of the theorem is proved: to see not only the statement is true, but also why it is true.

Reference [7], the ability to prove in mathematics (Algebra Abstract) consists of the ability to construct evidence and the ability to validate the evidence. The ability to construct proof includes the ability to use the methods of proof, definitions, entry, and theorem to demonstrate the truth of a statement in math (Algebra Abstract). While the ability to validate the evidence includes the ability to scrutinize the evidence related to the types proof that often arise in mathematics (Algebra Abstract). Activity validate the proof includes: (1) read a proof in mathematics to determine the truth or a mistake by looking at the suitability of the axioms of the system, the premise, the results of mathematical existing (entry or theorem), with the line of reasoning deductive, (2) completes the proof (if found to be a mistake), (3) compare the 'effectiveness' of the evidence with other proof [7].

From the perspective of cognitive development, [8] explains that the representation of developing proof through four stages, namely: proof enaktif (enactive proof), visual proof (visual proof), proof symbolic (symbolic proof), and proof formal (formal proof). Evidence enaktif, involve a physical demonstration to show the truth; visual proof, involving the creation of graphs or images; symbolic proof, involves manipulating the symbols of algebra; and formal proof involves deductive reasoning. Proof in mathematics has a very important role. These roles are identified by de Villiers [9] such as verification, explanation, systematization, invention, intellectual challenge, and communication. The role of *verification* might be most familiar with the study of mathematics; theorem is not a theorem until it has been verified that it becomes proof construction. The role of the *explanation* is often characterized by the evidence in the classroom. In many classroom context, the purpose is not evidence to show that the theorem is true, but to explain why the theorem is true. Of course, this role is not limited to the classroom. Role of *the invention* may be a little unusual. Historically, the theorem of several areas of mathematics, such as non-Euclidean geometry, are found through pure deductive ways. The role of proof *as communication* is emphasized by the fact that the evidence is written and read by humans, and therefore act as a means of communicating the proof of mathematical results between readers and writers. In addition, evidence can describe a new approach or technique, which may be another mathematician need to equip or prove themselves on different theorems.

Furthermore, how to measure student abstractions in constructing the evidentiary problem? As the *process of abstraction cannot be observed directly* [10], it has been necessary to define observable actions that can give information about the process. In defining the abstraction process, [2] has referred to the major observable epistemic actions as *recognizing*, *building-with* and *construction*, and hence named their model as "RBC". *The RBC Abstraction Model* is based on the activity theory, and comprises three epistemic actions. Some experts there who developed into RBC+C. Hershkowitz, Hadas, Dreyfus, and Schwarz investigate the development of understanding of probability among groups of Grade 8 students in Israel. Using an extended RBC+C model (RBC plus Consolidating), they analyse students' learning in considerable detail and demonstrate convincingly that their model allows the description of theoretical abstraction in terms of epistemic actions. In this study the authors used, RBC models for measuring abstraction students in constructing proof problems.

Recognizing refers to a familiar structure [11]. A previously constructed structure-already used in other situations - is related to this action [12]. Recognizing occurs when the student realizes that the construct that is familiar from a previous activity is connected to or relevant for the mathematical situation in the present activity. It may occur in at least two ways, by analogy and by specialization [10]. In the context proof algebra problems, about the topic in algebraic structures, namely the Group. Recognize the topic group, eg grupoid, semigrup, monoid, and groups. In addition, to get to know about the group, the student must also recognize the closed nature, associative nature, the element of unity / neutral element, inverse of an element, commutative properties. The properties of the group include: cancellation of the law, the existence of a single neutral element, inverse single, and theorems that follow.

Building-with refers to the process of combining familiar pieces of knowledge into a new context. It includes recognizing [11]. In other words, building-with is defined as using mathematical structures to achieve a given goal [12]. It reflects recognizing the familiar structure, and using it to solve the new problem. Actually, recognizing and building-with are nested actions where they complete each other. Most often, it is not possible to separate one action from the other. At this stage, combining some properties to get a new concept. The concept of the algebraic structure formed from several previous properties, eg if the set is not empty with certain operations satisfy the closed nature called grupoid. Grupoid that meets the associative nature called semigrup. In other words, semigrup is an empty set with no specific operation that meets the closed nature and associative. At this stage, combining some properties to get a new concept. The concept of the algebraic structure formed from several previous properties, eg if the set is not empty with certain operations satisfy the closed nature called grupoid. Grupoid that meets the associative nature called semigrup. In other words, semigrup is an no empty set with specific operation that meets the closed nature and associative. Monoid adalah semigrup yang memiliki elemen netral. Atau dapat dikatakan himpunan tak kosong dengan operasi tertentu yang memenuhi sifat tertutup, asosiatif, dan memiliki elemen netral. The Group is a monoid that each element has an inverse. Or a set is not empty with certain operations satisfy the closed nature, associative, has a neutral element, and every element has an inverse. While the group that meets the commutativity called abelian group. Abelian group means it meets the closed nature, associative, has a neutral element, each element of the inverse memeiliki, and meet the commutative properties.

Construction is the process of structuring new knowledge, also defined as processes of reorganizing and restructuring. Constructing is the process of restructuring and reorganizing what is recognized and known to construct a new meaning [11]. Reference [13], the process of construction - as the central epistemic action of abstraction comprises vertical reorganized knowledge, and requires theoretical thinking. Constructing is observed when the individual uses the structures he recognizes in solving the problem, given to teach a new mathematical concept. Construction is studied in this research is proving algebra problems. Means the process of reorganizing and restructuring in the proof of algebra problems. Proof algebra problem to show how the statement is true or false and also showed why the statement was true. Example: $G = \{(a, b) \mid a, b \in Z\}$, defined operations in G: $(a, b) \oplus (p, q) = (ap, b + q)$, $\forall$ $(a, b), (p, q) \in G$. Are $(G , \oplus)$ is a semigrup? Semigroup it must meet closed and associative properties. It means to prove (G, ⊕) semigrup means must be proved the truth of whether (G, ⊕) meets the closed nature and associative. To be able to show (G, ⊕) meets the closed nature and associative, means must know the definition of a closed and associative properties. The closed nature (G, ⊕): ($\forall$x, y $\in$G). x ⊕ y $\in$ G, and associative properties (G, ⊕): ($\forall$x, y, z $\in$ G). (X ⊕ y) ⊕ ⊕ z = x (y ⊕ z), this definition does independent on the form of the set and the operation is given.

Referring to the above description, to reveal about the ability of students to construct the proof abstraction algebra problems should be able to reveal the students' ability in recognizing, building-with, and construction (RBC). The problem is how to explore the ability of students to construct proof algebra problems through RBC? For that, the instrument used is not enough just to test, but there must be a supporting instrument that is able to explore the ability to construct the proof algebra problems. The purpose of this study to obtain an interview guidelines as support to explore the ability of students to construct the proof algebra problems.

II. METHODE

This study intends to obtain the supporting instruments of abstraction students in constructing proof algebra problems. To obtain a description of abstraction in constructing the proof problems in algebra, proving tests carried out algebra problems. To explore more about the abstraction, clarification with reference to the results of tests proving algebra problems. Based on these descriptions, this kind of research is exploratory qualitative research with the main data in the form of writing (test results proving a problem) and the words of the task-based interview. Subjects who used the trial is the student of mathematics education UNIROW Tuban have earned subjects algebraic structure.

To obtain valid data, conducted the interview. Interview questions referring to the investigation of abstraction students in constructing proof algebra problems, which have been made in the form of interview guidelines. The methods used are recorded through clinical interviews and audio visual equipment. Clinical interviews are used for capturing information about abstraction students in constructing proof algebra problems as a material to draw conclusions.

Supporting instruments to explore abstraction students in constructing proof algebra problems refer to the RBC (Recognizing, Building-with, and Construction). Topics algebra used is grupoid, semigrup, monoid, and groups. Broadly speaking, interview guidelines for constructing proof explore abstraction algebra problems are presented in Table 1.

TABLE 1. Interview Guide

No	Indicator	Question
1	Recognizing	Example: G = {(a, b) | a, b $\in$ Q^+}, defined operations in G: (a, b) ⊕ (p, q) = (ap, bq), $\forall$ (a, b), (p, q) $\in$ G. Show (G , ⊕) is a grup? a. Give an example of a member of the set? b. Give examples that are not members of the set G? c. Determine the operating results (2, 5) ⊕ (3, 1) = ... d. How is the definition of a group? e. How definitions the closed nature? f. How definitions (G, ⊕) closed? g. How does the definition of associative nature? h. How definitions (G, ⊕) associative nature? i. How does the definition of neutral element? j. How definitions (G, ⊕) has a neutral element? k. How is the definition of the inverse? l. How definitions (G, ⊕) each element has an inverse? and can ask some properties or theorems supporting proof
2	Building-with	This section asks some combination of definition on the part Recognize, eg: a. Is groupoid is semigrup? Why? b. Is groupoid is a monoid? Why? c. Is grupoid is a group? Why?

		d. Is monoid is grupoid? Why? e. Is monoid is semigrup? Why? f. Is monoid is a group? Why? g. Is semigrup is grupoid? Why? h. Is semigrup a monoid? Why? i. Is semigrup is a group? Why? j. Is a group grupoid? Why? k. Is a group semigrup? Why? l. Is group is a monoid? Why? m. What should be shown if it will prove grupoid? Why? n. What should be shown if it will prove semigrup? Why? o. What should be shown if it will prove monoid? Why? p. What should be shown if it will prove a group? Why? And others.
3	Construction	In this section, will explore the ability to construct the proof. After the students are faced with the problem of proof, the questions: a. To prove the above problem, what do you show? Why? b. What do you think, if the proof is not in sequence? Explain! c. How is your conclusion, if one of the conditions there are not proven? Why? d. How do you move to prove the closed nature of the problems mentioned above? Write / explain! e. How is your conclusion, if the closed nature is not fulfilled? Why? f. How do you move to prove the associative nature of the problems mentioned above? Write / explain! g. How is your conclusion, if the associative nature is not fulfilled? Why? h. How do you move to show the existence of a neutral element in the above problem? Write / explain! i. How is your conclusion, if it does not have a neutral element? Why? j. How do you move to show that every element has an inverse? Write / explain! k. How is your conclusion, if there are elements that do not have an inverse? Why? l. Based on the steps proof that you do, what your final conclusion? Why? m. And others.

Furthermore, the trial to students who have earned courses Algebra Structure. Selected as the subject of trial are two students of the AD and the US are female. The problem that used trial: Let G = set of positive rational numbers. Operation is defined in G as follows: $a * b = ab / 3$, $\forall a, b \in G$. Prove that (G, *) is a group!

The trial results were analyzed qualitatively. This results to determine whether a supporting instrument in the form of interview guidelines have been able to measure the ability of students to construct proof abstraction algebra problems (valid). In addition, conducted the validation the validator to determine the accuracy of questions both in terms of content, construct, and the language used.

III. RESULTS AND DISCUSSION

This section describes the trial results and discussion. The trial is to test the interview guidelines of what is already able to explore abstraction students in constructing proof algebra problems. The following profile trial results according to the indicators used, namely: Recognizing, Building-with, and Constructing.

Recognizing

Based on the order of introduction, recognizing refers to the ability of students to know all the facts, concepts that may be used as a knowledge base for proving problems. The problem used is proof of the group. The trial results may indicate that the student is able to recognize some of the facts, concepts that may be used for verification. However, there are some that need repairs sentence, the indicator some students looked puzzled, because do not understand the question. The next sentence made simpler, so the question is more easily understood. Here are excerpts of interviews with AD, after working on the problem proving: Let G = set of positive rational numbers. Operation is defined in G as follows: a * b = ab / 3, ∀a, b ∈G. Prove that (G, *) is a group!

Researcher	Whether the problem is easy to understand?
AD	Yes, Insya Allah
Researcher	What are you trying to prove?
AD	…Group
Researcher	How is the definition of a group?
AD	The set G with operations asterisk ("*") ..., meet closed, associative, and each element has an inverse
Researcher	How the neutral element?
AD	... Oh yes there are four condition, the third condition unkes ("the element of unity")
Researcher	How definitions the closed nature?
AD	Hmmm ... any two elements in G, results of operations stars in G.
Researcher	Good, then how the definition of associative nature?
AD	Each ...., Three elements in G, a result like this ... x star in brackets y z star, together with, in brackets star x y then z star
Researcher	What can be written in symbolic?
AD	Yes sir ... like this
Researcher	If the definition of neutral elements how?
AD	Each element in G ...., Eh not, there is an element e in G, if e star by any element in G results remain
Researcher	Good, how the definition of the inverse?
AD	Hmm ..., every element x in G, there is an inverse x in G, so x star x inverse result is a neutral element e.

Based on the interview excerpt above, it can be said that the subject of AD, is able to reveal the group definition, the closed nature, associative, neutral element, and inverses of an element. This means that, the subject of AD in "recognizing" shows a good ability. Likewise, other subjects such as the US shows the ability of recognizing pretty good. It can be concluded that the interview guides were able to uncover the ability of recognizing. In line with the opinion of [4] recognizing refers to the learner realizing that a specific previous knowledge construct is relevant in the situation at hand. In the quote above is not asking for some theorems related to the group that may assist/support in the proof. However, because of proving problems that used only prove problematic enough group evidenced by definition. Recognizing refers to a familiar structure [11]. Actually that is supportive of the problems evidenced, the student is not enough just to mention the closed nature, associative, neutral elements, and each element has an inverse, but also must be able to know the definition.

Building-with

Building-with refers to the combination of several facts or concepts, thus forming a mathematical structure 'new'. This activity is related to the ability to recognize, if in recognizing less good, then chances are the building-with too less well, and otherwise. Actually, recognizing and building-with are nested actions where they complete each other. Most often, it is not possible to separate one action from the other [14]. Based on trial results shows the ability of the subject building-with fairly good. Here are excerpts of interviews with US after working on the problem proving.

Researcher	Now kindly be informed, if four condition for prove the group, only fulfill one condition ie the closed nature of what can be called a group?
AD	No ... it's called groupoid
Researcher	If the condition is fulfilled only associative nature is called what?
AD	Hmm .... do not know
Researcher	So, how the definition grupoid?
AD	only meets the closed nature.
Researcher	If grupoid meet associative nature, it is called ...?
AD	It…., hmm…. Semigroup
Researcher	How semigrup definition?
AD	Which meets the the closed nature and associative
Researcher	Another definition?
AD	Oh ... yes, grupoid that meets the associative nature.

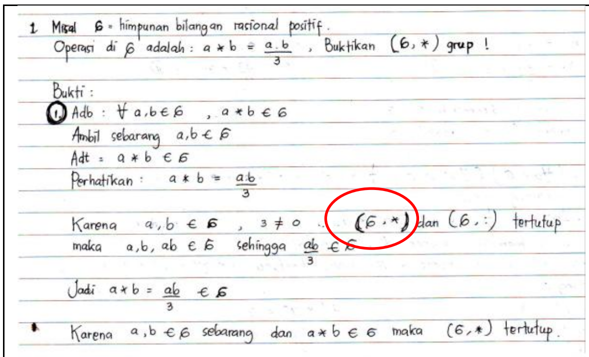
Researcher	Monoid, how the definition?
AD	Hmmm ... .. repeat
Researcher	How does the definition of monoid?
AD	Which meets the the closed nature, associative, and has a neutral element.
Researcher	Try define monoid using groupoid or semigrup!
AD	Monoid mean ... it semigrup which has a neutral element, or ... groupoid which meets the associative nature and has a neutral element.
Researcher	If the group meets commutative properties, it is called ....
AD	It was ... .. the group is commutative, or abelian.

The above excerpts of interviews have shown an ability building-with US. Students are able to show building-with by combining the closed nature, associative, neutral elements, each element has an inverse, and commutative properties. This was in line with [4] building-with comprises the combination of recognized constructs, in order to achieve a localized goal such as the actualization of a strategy, a justification or the solution of a problem. The model suggests constructing as the central epistemic action of mathematical abstraction. Based on these facts it can be said that the interview guides were able to explore the potential of building-with of the subject.

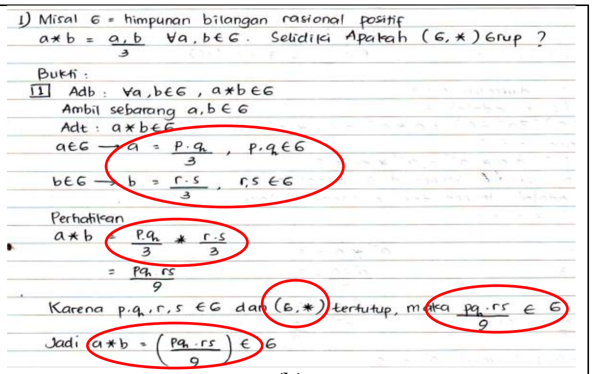
Constructing

This section is the main part in the shows the abstraction students. Reference [4] constructing consists of assembling and integrating previous constructs by vertical mathematization to produce a new construct. It refers to the first time the new construct is expressed or used by the learner. This definition of constructing does not imply that the learner has acquired the new construct once and forever; the learner may not even be fully aware of the new construct, and the learner's construct is often fragile and context dependent. Results of tests on the AD and the US shows the constructing pretty good. Although logically still found a few steps 'no' logical.

The first step, we look at the answers to the AD and the US in proving the closed nature, the first condition for proving the group. In answer to AD, the first step to write the definition of the closed nature of the symbolic; AD means recognizing the definition of the closed nature. But in part the reason (see the sign ellipse) is not logical, because of (G, *) is closed is to be shown the truth. In addition to the operation '*' does not exist, that there is only a.b (multiplication). However, the end result proving the closed nature of the right. (Fig. 1 (a)). Reference [9] explains that a proof of a mathematical theorem is a sequence of steps that lead to the desired conclusion. Rules to be followed by a sequence of steps that made explicit when the logic formalized. Reference [15] reasoning, proof and arguments in the mathematics classroom is an important issue in the study of mathematics education.



(a)



(b)

FIGURE 1. Proof the closed nature, subject AD (a) and US (b)

In answer to US, the definition of the closed nature symbolically it is true, but elaboration of step, membership G, is wrong (Fig. 1 (b)). It is the possibility of the US do not understand about the set of rational numbers, so write if a $\in$ G, then a = pq / 3. Whereas pq / 3 is the operation of p * q. The mistake in defining the membership set, resulting in the end result was wrong. Step illogical conducted AD, also found in the US answer, namely: (G, *). Reference [16] asserts that the proving clearly has the purpose of validation confirms the truth of a statement by examining the logical correctness of mathematical argument. In the second proving, proving the associative nature. (Fig. 2). And the answer of AD, there is a mistake in operating, although the end result, the left side is equal to the right side. Even at the conclusion finally obtained meet asosistif nature, but the proving is considered wrong, because of the conclusion was obtained from the process is wrong. In answer to the US, are correct. In the US proving associative nature, does not elaborate on the membership of G, so as not to make a mistake.

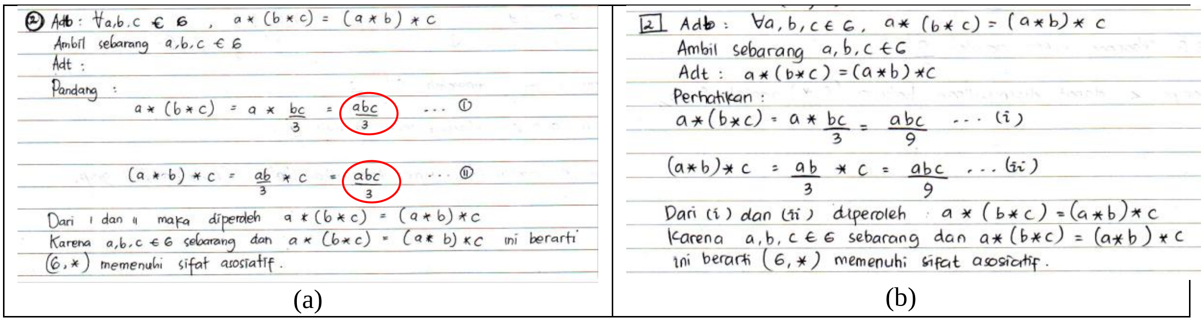


FIGURE 2. Proof of associative nature, subjects AD (a) and US (b)

Noting some of proof do the AD and US, shows that constructing can be found in error, although at recognizing and building-with an excellent result. However, in general, the ability of the students recognizing and building-with good, then constructing would also be nice. Reference [2] a student cannot get to the building-with and construction stages if he cannot "recognize". Also, a student who can "recognize" has to perform both actions of recognizing and building-with in order to "construct". This mechanism is called *the dynamic nesting of the epistemic actions*.

A similar incident occurred when proving the existence of a neutral element, both the AD and the US have an answer that shows the truth logically. Likewise, in answer to proving every element has an inverse, AD and US can shows the logically. Finally, the AD and the US can be concluded well that (G, *) is a group. Here are the answers to the US on proving that every element in G has an inverse in G. (Fig. 3)

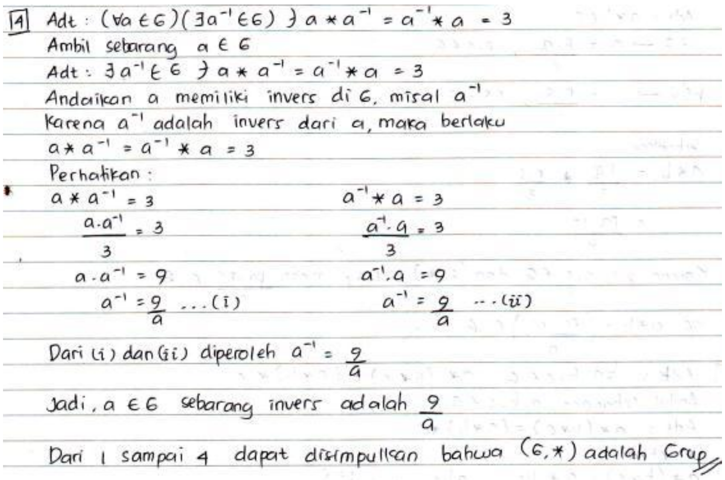


FIGURE 3. Answer US in inverse proving.

Answer US on proving already shows the inverse logical clarity. Likewise conclusion, the proving obtained from: (a) the nature of the closed, (b) associative nature, (c) the existence of a neutral element, and (d) each element in G has an inverse. Conclusion (G, *) proved to be a group. If we look closely, step proving carried US, especially on the proving the closed nature, there are some steps that are not logical. But at the end of proving, the conclusions obtained proved to meet the closed nature. As a result, all that is conditioned to shows a group can be met, so the conclusion (G, *) is a group.

IV. CONCLUSION

Abstraction is a vertical reorganization activities mathematical concept which had been constructed earlier to a new mathematical structure. Mathematical concepts combined, restructured, organized and built up to more abstract or more formal. How to test the student abstractions in constructing the proof? In this study using a model Recognizing, Building-with and Constructing (RBC). *Recognizing* refers to a familiar structure. Recognizing occurs when the student realizes that the construct that is familiar from a previous activity is connected to or relevant for the mathematical situation in the present activity. *Building-with* refers to the process of combining familiar pieces of knowledge into a new context. In other words, building-with is defined as using mathematical structures to achieve a given goal. *Construction* is the process of structuring new knowledge, also defined as processes of reorganizing and restructuring. Constructing is the process of restructuring and reorganizing what is recognized and known to construct a new meaning. To explore the potential of students in constructing proving abstraction algebra problems using RBC models. Supporting instruments which refers to the RBC models designed interview guidelines. Based on the analysis, the research concluded: *Recognizing*, students tend to be able to know a few facts, concepts that support the proof problem, for example: the definition of the closed nature, associative, neutral element, inverse of an element. Students are also able to explain the definition of grupoid, semigrup, the group very well. *Building-with*, students tend to be able to combine the concept of the closed nature, associative, neutral element, inverse of an element, in defining grupoid, semigrup into new contexts that are interrelated. Students are also able to combine the definition of the group, monoid, semigrup, grupoid, and abelian groups. *Constructing*, students in constructing proof algebra problems still many steps that are illogical in the use of facts or concepts. For example: the show proof enclosed nature illogical in its operations; proof neutral element of found the steps that are not rational. As a result, proof tends to incorrect, although ultimately correct conclusion. So the proof construction algebra problems in declared less successful, because the conclusions derived from evidentiary less logical step.

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An Analysis of Student's Error in Solving PISA Problems

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Abstract— Based on PISA survey in 2012, Indonesia was only placed on 64 out of 65 participating countries. The survey suggest that the students' ability of reasoning, spatial orientation, and problem solving are lower compare with other participants countries, especially in Shouth East Asia. Nevertheless, the result of PISA does not elicit clearly on the students' inability in solving PISA problem such as the location and the types of student's errors . This case would consider on further research in finding students' error in solving PISA problem including its type and location. Therefore, analyzing students' error in solving PISA problem would be essential countermeasure to help the students in solving mathematics problems and to develop scaffolding. This paper will discuss the categories of the students' error analysis based on Newman analysis that consist of of reading and decoding, comprehending, transforming, processing and encoding. The result obtained from junior high school in Surabaya support categories on students' error from each four different context as (1) personal, (2) occupational, (3) social, and (4) scientific. Baed on the analysis of the study, it is found that there are 5 types of error which is made by the subject. They consist of reading error, comprehension error, transformation error, process skill error, and encoding error. The most common mistake that subject do is encoding error with a percentage of 26%. While reading is the fewest errors made by the subjects that is only 12%. Both transformation and process skill errors have the same percentage of the number of mistake is 24%. Lastly, 14% of the made mistake is in comprehending PISA problem. In the other hand, the context of PISA problem which has the most error is scientific context with a percentage of 43%. While occupational context problem has the fewest mistake which is only 12%.

Keywords: *Analysis of Student's Error, PISA, Newman Analysis.*

I. INTRODUCTION

Program for International Student Assessment (PISA) is a program for assessing student's ability in International scope that was managed by Organisation for Economic Cooperation and Development (OECD). One aspect that assessed by PISA is the ability of students to apply mathematical context in variety situations in daily life. Therefore, PISA instruments is the real problems that require the ability in reasoning, spatial orientation and problem solving (OECD, 2013a).

In 2012, the result of OECD show that Indonesia was only places on 64 out of 65 participating countries in mathematics context which only gained 375 points. It suggest that Indonesian students ability in employing mathematics knowledge in their life is low. In the other hand, OECD stated that mathematics is strong predictor of a person's success in his youth. Moreover, it also affects the ability of class participation and the expectations of future earnings.

In fact, student's inability in solving PISA problem is caused by the lack of student skill in modelling daily life sentences into mathematics sentences. Moreover, this is also supported by the role of teachers in which they do not realize their mistakes in learning process that make student's errors in solving mathematics. The teachers tend to give the problems and the direct formulas without connecting the situations of daily life and mathematics concepts. As a result, students become confused and make mistakes in solving the next level of PISA problems.

To sum up, it is beneficial for Indonesia to improve PISA scores in subsequent years. For these improvements, we are interested in analyzing student's errors in solving PISA problems, especially in the matter of mathematics. These activities will provide an overview of student's thinking in solving PISA based on their erros's analysis. Hence, these results can be used as the references to make improvement in mathematical student's ability of PISA level.

Regarding to the purpose of the study which is to describe the types and the location of errors in solving PISA problems, there are benefits of this research as follows: (a) For lecturers, this study can be used as consideration in determining topic of student's thesis or final projects in their lecture, and (b) For mathematics teachers, this study can be used to determine the action plan to overcome student's mistakes in solving mathematics PISA problems by developing a model or a method of mathematics learning.

II. RESEARCH METHODS

This study is an exploratory research by using qualitative approach hence it will generate descriptive data such as the desription of the types and the location of student's errors in solving PISA problem, which is amounted 4 questions. In this study, researchers act as observers and interviewers to determine student's mistake in solving PISA problem.

This study was conducted in SMP Muhammadiyah 17 Plus Surabaya in the even semester of 2015/2016. The research subject is the selected students in 8^{th} grade which is determined by their mistakes in solving PISA problem. The problems is adjusted to each content in PISA 2012, namely change and relationship, quantity, space and shape, and uncertainty.

There are three phases of a qualitative research approach, namely the preliminary phase, the core phase and the data analysis phase.

A. The Preliminary Phase

The researcher made an agreement with mathematics teacher of research's subjects and discussed about the mathematical content which has been obtained by the students who will be research subjects. The next activity is the preparation of research instruments. In this study, the main instrument is the researcher due to the fact that we are a determinant in research process and an observer in colecting data in the field, such as in-depth interviews on the subject to obtain the necessary information in data collection. Whilst, the other instruments that has been used in this study are PISA Test Problem and Interview Guidelines. PISA test problems is arranged to reveal student's error in solving PISA problem which is rarely gotten by the students. While interview guidelines instrument is prepared to identify the mistakes that was done by the students when they solved PISA problem and to probe their reason of their errors.

B. The Core Phase

This activity begins with the selection of research subjects based on the result of PISA test that was given earlier. Each subjects represents a type of error according to Newman analysis. In addition, the subjects is also based on the communication skill and the similarly mathematical ability. The communication skill meant that student had no difficulty when communicate orally and be able to express his opinion. The next activity is doing semi-structured interview with the selected subjects in more depth in order to verify the result of data recorded. As a result, both the interview data and PISA test data are the initial data to do the analysis of data.

C. The Data Analysis Phase

The purpose of this phase is arranged the data be structured sytematically and easily intrepeted. Actually, the data analysis will be done using descriptive analysis to disclose student's errors in solving PISA probem which is refer to Newman analysis. In addition, there three stages of analysis data process, namaely data reduction stage, data exposure stage and drawing conclusion stage. The former refers to sharpening process, selecting, focusing and transforming the obtained raw data. Then, it will be selected, simplified and grouped with the corresponding data in order to answer the research question. The second stage is classifying and identifying the set of organized data in the form of narrative text, charts and others hence it is possible to draw a conclusion. As a result, the set of data that has been reduced, classified, identified is allowing the researcher to draw conclusions on the analysis of student's error in solving PISA problem which is refers to Newman Analysis.

III. RESULT AND DISCUSSION

There are 5 students that have been selected as research subjects. It can be clearly seen that their response in solving PISA problems have been analyzed and categorized into Newman's 5 types of errors. Then, the type of error made by the subject will be discussed further on the error's analysis which are made by each of them. Here is a discussion of the error analysis of each subject when they solved PISA problem with different contexts.

TABEL 1. ERRROR'S ANALYSIS OF SA-RESPONSES

Type of error	Test Item				Total
	1 (Social Context)	***2 (Occupational Context)***	***3 (Personal Context)***	***4 (Scientific Context)***	
Reading			√	√	2
Comprehension	√			√	2
Transformation			√	√	2
Process Skill	√		√	√	3
Encoding	√		√	√	3
The number					12

TABEL 2. ERRROR'S ANALYSIS OF SB-RESPONSES

Type of error	Test Item				Total
	1 (Social Context)	***2 (Occupational Context)***	***3 (Personal Context)***	***4 (Scientific Context)***	
Reading					0
Comprehension	√			√	2
Transformation				√	1
Process Skill	√	√		√	3
Encoding		√		√	2
The number					8

TABEL 3. ERRROR'S ANALYSIS OF SC-RESPONSES

Type of error	Test Item				Total
	1 (Social Context)	***2 (Occupational Context)***	***3 (Personal Context)***	***4 (Scientific Context)***	
Reading					
Comprehension	√				1
Transformation	√		√	√	3
Process Skill			√		1
Encoding			√		1
The number					6

TABEL 4. ERRROR'S ANALYSIS OF SD-RESPONSES

Type of error	Test Item				Total
	1 (Social Context)	***2 (Occupational Context)***	***3 (Personal Context)***	***4 (Scientific Context)***	
Reading			√	√	2
Comprehension				√	1
Transformation	√	√			2
Process Skill		√			1
Encoding		√	√	√	3
The number					9

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TABEL 5. ERRROR'S ANALYSIS OF SE-RESPONSES

Type of error	Test Item				Total
	1 (Social Context)	***2 (Occupational Context)***	***3 (Personal Context)***	***4 (Scientific Context)***	
Reading				√	1
Comprehension				√	1
Transformation	√			√	2
Process Skill	√			√	2
Encoding	√			√	2
The number					8

TABEL 6. ERRROR'S ANALYSIS OF ALL STUDENTS RESPONSES

Type of error	Test Item				Total
	1 (Social Context)	***2 (Occupational Context)***	***3 (Personal Context)***	***4 (Scientific Context)***	
Reading	0	0	2	3	5
Comprehension	2	0	0	4	6
Transformation	3	1	2	4	10
Process Skill	3	2	2	3	10
Encoding	2	2	3	4	11
The number of errors	10	5	9	18	42

Explanation:

: Uncorect Student's Response with Newman's Error Analysis

: Correct Student's Response

: No Response

Based on their general response in solving PISA problem with 5 different context, the most mistake that have been done by them is encoding error with percentage of 26%. Then, the another error that has the lowest percentage is reading error with 12%. While, 24% of mistakes are process skill error and transformation error. The remaining 14% of the made mistakes is comprehension error.

In the other hand, the PISA context which has the most error is scientific context with a percentage of 43%. Meanwhile, occupational context problem has the less mistake that is only 12%. Then, personal context problem and social context problem consequtive has an error percentage of 21% and 24%.

A. Reading Error

Reading error is a condition when subjects have difficulty with reading and hard to establish a context for a particular text, predict its grammatical structure and predict the meaning of the text. In this study, subjects do mistake in reading the main information of the problem hence they did not apply its information in solving problem. Moreover, reading error done by subjects in scientific and personal context of PISA problem.

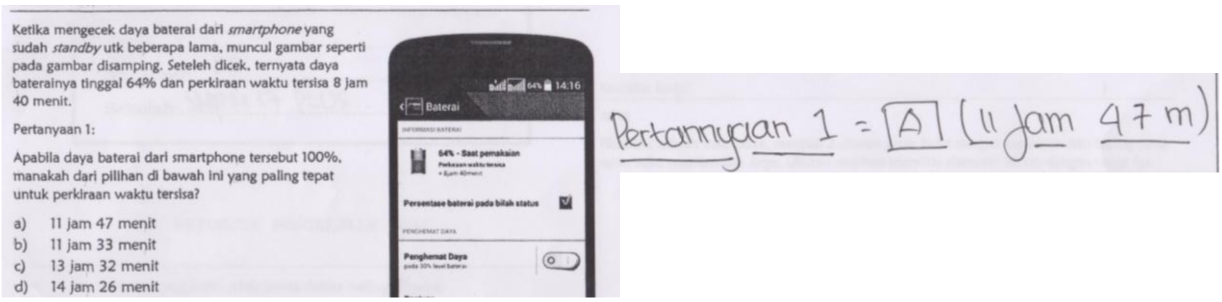

FIGURE 1. SD'S RESPONSE ON SCIENTIFIC CONTEXT OF PISA PROBLEM

Based on the result, SD did not apply the information on the question due to the fact that he did not read the main information. Moreover, based on the interview, he said that he didn't know the meaning of "standby" on the question hence he decided to choose option A.

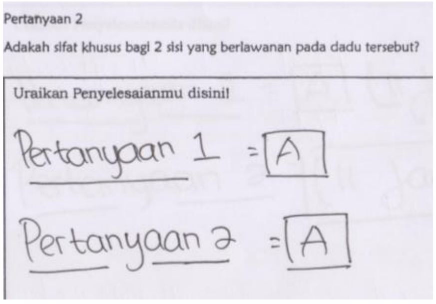

FIGURE 2. SD'S RESPONSE ON PERSONAL CONTEXT OF PISA PROBLEM

Based on SD's response on personal context of PISA problem, his response is not accordance with the question which he have to explain about the special characteristic of the opposite dices . Based on the interview, subject argued that the answer of question 2 is equal to the question 1, so he decided to choose option A as his answer.

B. Comprehension's Error

Comprehension error is a mistake when subject missunderstand what the problem ask and collect information from the problem insufficiently. In solving PISA problem, subject perform coprehension error on the saintific and social context of PISA problem. In the following is the subject's response on those context with the explanation. .

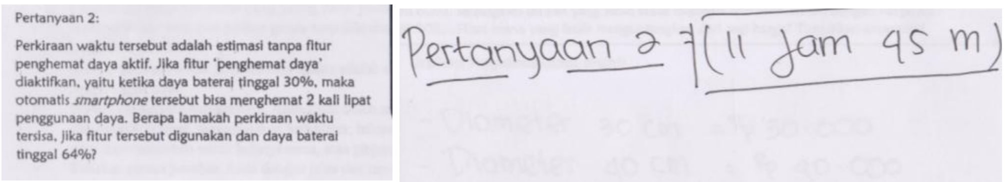

FIGURE 3. SD'S RESPONSE ON SCIENTIFIC CONTEXT OF PISA PROBLEM

Based on interview, SD does not comprehend the meaning of the queston implicitly between "fitur baterai" and "penghemat daya" hence SD only write the answer based on alternative response provided in question 1.

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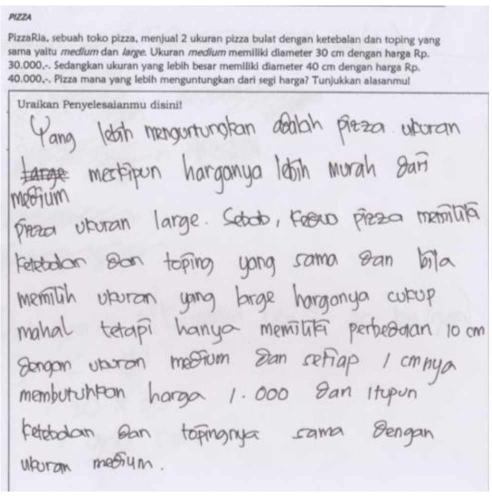

FIGURE 4. SC'S RESPONSE ON SOCIAL CONTEXT OF PISA PROBLEM

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SC also make a mistake in comprehending PISA problem on social context. Based on the interview, SC missunderstand with what question ask about “menguntungkan’. Therefore, subject got confused in writing an appropriate solution.

C. Transformation’s Error

Transformation error is a mistake when subject can not change the question into mathematics model correctly. This mistake occurs in all contexts of PISA problem where two questions which get the most error is on social and scientific context..

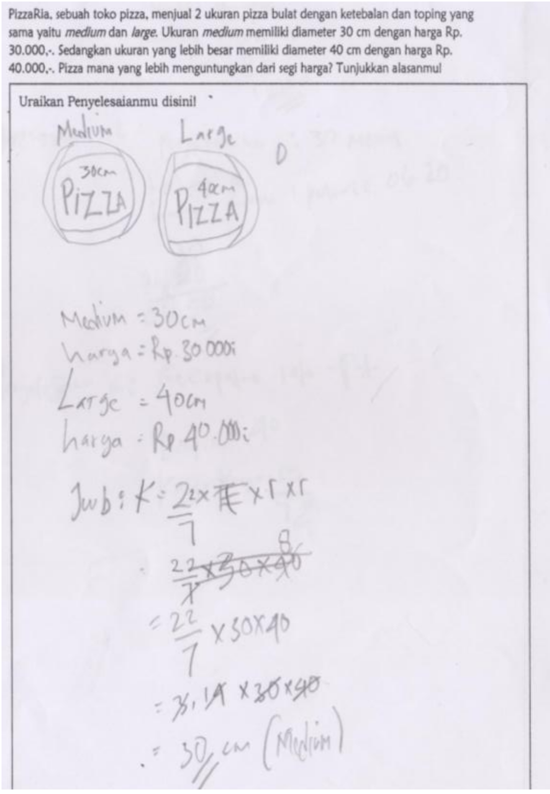


FIGURE 5. SE’S RESPONSE ON SOCIAL CONTEXT OF PISA PROBLEM

Subject make transformation error when he write the area of circle by “ $K = \frac{22}{7} xrxr$ ” with r_1 = 30 cm and r_2 = 40 cm. In fact, the area of cicle must be written in symbol “L” and the radius have the equal length.

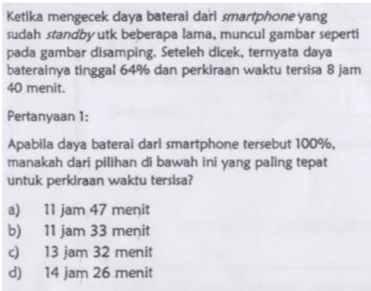
D. Process Skill Error

Process skill error is a mistake occuring because subject does not master in calculating mathematically. Therefore, this mistake make the subject give the response uncorrectly. This study suggest that the most error in process skill occurs on social and scientific context of PISA problem.

In figure 5, SE do a mistake in multiplication process “3.14 x 30 x 40 = 30 cm”. In interview process, SE stated that subject cancel out the same number are 3 and 4 such that 30 obtained from the calculation. In addition, subject also stated that his teacher commonly used thus method in division process so subject consider that cancel out method can be used in multiplication process.

E. Encoding's Error

Encoding error is a mistake when the subject write the final answer which is not accordance with what question ask. In this study, PISA context problem which getting the most error in encoding answer are social and scientific context.



Ketika mengecek daya baterai dari *smartphone* yang sudah *standby* utk beberapa lama, muncul gambar seperti pada gambar disamping. Seteleh dicek, ternyata daya baterainya tinggal 64% dan perkiraan waktu tersisa 8 jam 40 menit.

Pertanyaan 1:

Apabila daya baterai dari smartphone tersebut 100%, manakah dari pilihan di bawah ini yang paling tepat untuk perkiraan waktu tersisa?

a) 11 jam 47 menit
b) 11 jam 33 menit
c) 13 jam 32 menit
d) 14 jam 26 menit

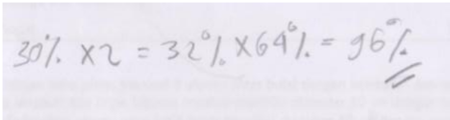


FIGURE 6. SE'S RESPONSE ON SOCIAL SCIENTIFIC OF PISA PROBLEM

Based on the subject work, the answer 96% is not accordance with what the problem ask about how long the remaining times in times unit. Based on the interview, subject consider that the answer of question 2 is about the percentage of the remaining time.

IV. CONSCLUSION AND SUGGESTION

Based on the result, it is found that there are 5 types of mistakes made by the students namely reading error, comprehension error, transformation error, process skill error and encoding error. The most common mistake which are have been done by the subjects is encoding error with a percentage of 26%. While reading is the fewest errors made by a subject that is only 12%. Both transformation and process skill error possessed the same percentage of the number of errors is 24%. The last, 14% of the made mistakes is an error in understanding the problem of PISA.

In this study, PISA problem is adopted from PISA 2012 where the predominant domain is mathematics. Thus, there are 4 selected PISA problem that each question has a different context namely social, personal, occupational and scientific. PISA Problem with the most errors is scientific context with a percentage of 43%. Meanwhile, PISA with occupational context contains only 5 out of 42 errors. The rest, both personal and scientific context in succession problem has a percentage of error of 21% and 24%.

Based on the conclusions, the writer can provide input for other researchers, teachers, students and schools. For other researchers, they need to analyse further on-students error in solving PISA problems that have different content. As for teachers, it is required the learning of PISA types of problems in mathematics teaching so that students are familiar with the form of the question. In addition, students should also be open to their teachers if experiencing difficulty when doing on math problems.

ACKNOWLEDGMENT

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ME – 43

Integrating Technology in Inquiry Based Learning

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Abstract— There are two important things to be of interest in accordance with the vision of NCTM in mathematics education, ie knowing mathematics in the 21st century and the need to continue enhancing the role of mathematics education to answer the challenges of a changing world. One of the competencies associated with the great challenges of the 21st century is benefiting from the support and tools (including IT), such as: know the existence and nature of the various tools for mathematical activity. In the era of technological advances such as the current graphics software support is very abundant and can be used as an attempt to improve the learning outcomes of mathematics learners. In addition, the student of Mathematics Education as a pre services teacher should receive the widest provision in the control or utilize the skills of computer software, in order to answer the demands in the job market. This paper describes the integration of technology in the inquiry based learning at the college level. Thus, the integration of technology in inquiry based learning in mathematics is expected to generate a deeper understanding and flexible in accordance with the development of education that can't be separated from the development of technology.

Keywords*:* *technology, inquiry based learning*

I. INTRODUCTION

The progress and development of technology was integrated into many life area's, including economics, health, transportation, education and the others. The use of technology in various fields of course adapted to each field. In the education, technology comes in many forms. Computer as a part of technology can act as a instructional media to facilitate the learning process as well as separately instill the concept to students.

NCTM's vision shows the importance of two things in mathematics education, there are to know mathematics in the 21st century and the need to continue to improve mathematics education to answer the challenges of a changing world. One of the competencies associated with the great challenges of the 21st century is benefiting from the support and tools (including IT), such as: know the existence and nature of the various tools for mathematical activity [1]. In the era of technological advances such as the current graphics software support is very abundant and can be used as an attempt to improve the learning outcomes of mathematics learners. In addition, students of Mathematics Education Programs as a pre services teacher should receive the widest provision in the control or utilize the skills of computer software, in order to meet the demands in the job market. Learning Differential Calculus accompanied by "Mathematica" produce satisfying achievement for students indicated 88% of students receive a minimum value in the category B- or thoroughly studied and the increased independence of student learning (Listyani, Dhoruri, and Setyaningrum, 2006).

Other standards that must also be met by a math teacher is the knowledge of technology. A prospective teacher should be able to take advantage of technology as an important part in the learning of mathematics. An indicator of the standard of knowledge about the technology are: 1) using mathematical knowledge for selecting and using appropriate technology, but not limited to worksheets, dynamic graphics tools, computer algebra system, statistical tools, dynamic graphing calculators, data collection tool and software presentation.

Inquiry mathematics is a learning model that encourages students to organize their own activities while learning math statement. In the inquiry mathematics, students take responsibility for directing the lesson with the teacher guiding the activities undertaken mathematics students in the classroom.

The involvement of students in inquiry mathematics starts from asking a question, make a conjecture, plan and monitor the activities of their mathematics, explored the idea in collaboration with friends, to identify when they will " requires new knowledge, ask the teacher about the mathematics they learned, explaining the reason answer and prove the results of their answers. While activity in the inquiry mathematics teachers are utilizing the curiosity of students, linking concepts and procedures, motivate students, to build an open inquiry, combining different forms of reasoning, develop initiative, independence and leadership students. According [2] guided inquiry learning methods lead to active participation in the learning process. This learning method improve students' ability to analyze, synthesize, evaluate and relate the concepts contained in the various disciplines of learning and everyday life, thus causing material studied more relevant for students.

II. Discussion

Based on the above introduction, the discussion in this paper will focus on the integration of technology in learning inquiry.

A. *Inquiry Based Learning*

Inquiry is a term that is used both in education and in everyday life to describe how to find the knowledge or information by asking questions. Inquiry mathematics present clear similarities with scientific investigation [3]. As scientific inquiry, inquiry mathematics began from a question or a problem, and the answer is sought through observation and exploration; conduct experiments; make the connection; recognize the corresponding mathematical techniques when needed.

In the Primas Report, inquiry described as a deliberate process ranging from diagnosing problems, critiquing, experiments, and distinguishing alternatives, planning investigations, researching allegations, searching for information, constructing models, debating with peers, and forming coherent argument. Use of Inquiry Based Learning is good for mathematics and science education.

In inquiry learning, educator role as provocateur, means teachers (educators) served to motivate the students to develop initiative, independence and leadership as well as arouse the curiosity of students. Curiosity beginning students to conduct an investigation is one of the great challenges in Inquiry-based learning. In this process, educators play an important role. Teachers contribute and expand ideas, how to question and how to investigate a person's ideas or theories. Teachers should find creative ways to introduce students to ideas and subject matter that interests them and offer the potential inquiry or provide an opportunity for students to engage in the ongoing Inquiry. When individuals and small groups of students took a different approach to certain questions thoroughly in the classroom, the teachers develop classroom culture where there are ideas that emerged from each student. By hearing the views of others, students have a better understanding of their own ideas and approaches to questions and issues.

According [4], Learning inquiry provides the opportunity for children to develop the knowledge, skills, and habits of thought that lead to a deeper understanding of their world and human experience. The process of inquiry focused on developing an interesting question, which is formulated by the teacher and the child, motivating and guiding questions into topics, issues, and issues related to the content and outcome of the curriculum.

Inquiry learning is more than a simple learning method. Learning inquiry is a philosophical approach to learning and teaching, based on research and constructivist methods, involving children in the investigation that led to the disciplinary and transdisciplinary understanding. Learning inquiry built on curiosity and wonder inherent in children, backgrounds, interests, and experiences. The process provides an opportunity for children to be active participants in a collaborative quest to acquire meaning and understanding. Children who engage in inquiry activities as follows: 1) building a knowledge and a deep understanding, not just passively receiving knowledge, 2) directly involved in the discovery of new knowledge, 3) find ideas that contradict that transform knowledge and previous experience into a deeper understanding, 4) transferring new knowledge and skills to the new situation, 5) is responsible for on going learning and mastery of content and skills curriculum.

Inquiry learning motivate children to explore topics in a meaningful context. The investigation process is not in the steps rigid, but flexible and recursive. Experienced teacher inquirers will move back and forth through the process cycle as new questions arise and the children become more comfortable with the process.

Questions of good questions formulated in a broad and has many possibilities. They encourage children to explore, gather information, plan, analyze, interpret, synthesize, solve problems, take risks, make allegations, concluded, documenting, reflecting learning, and develop new questions for further investigation [4]. As educators, teachers are faced with the challenge and sensitivity in engaging students in learning so that they develop the skills and knowledge they need for daily life.

According [5], the method of inquiry can be done through expository, groups and individuals. In the method of inquiry, the final results are found students is something new for him and also not known by the teacher. In this method, in addition to sebgai guides and counselors, teachers also become resources necessary data. Students still have gathering additional information, make a hypothesis and test it. Examples of topics for inquiry in schools is to determine the density of traffic at the intersection, determine the wasted water from the faucet plumbing damaged, determines much water a river stream.

One of the goals of teaching with inquiry is for students to know and be able to transferring knowledge into other situations. This method consists of four stages, namely: 1) teachers stimulate students with questions, problems, games and puzzles, 2) In response to the stimuli it receives, the students determine the procedures seek and collect information or data that is needed to solve the question, statement and problems, 3) Students appreciate the knowledge gained by the new inquiry conducted, and 4) Students analyze methods of inquiry and procedures found to be a general method that can impose on other situations.

Learning inquiry is one based on the constructivist learning. Mathematics merely as a tool for thinking, the main focus of learning mathematics is to empower students to think construct mathematical knowledge discovered by experts earlier [5]. According [5], mathematics learning approach is the way in which the teachers in the implementation of learning to the concepts presented can be adapted by the students. There are two types of approaches in the learning of mathematics, which is an approach that is methodology and approach are material. While this method of learning is a way of presenting the material is still common, for example, a teacher presents the material with a dominant submission verbally and once in a while there is a question and answer. Each teacher can do a lecture as it was in accordance with their respective fields.

According to Justice et al (2002), inquiry learning process is a cycle in which the students are involved in a topic, develop a question to be explored, determine what information is necessary, collect data, synthesize inventions, discoveries and evaluate the immediate success communicate the inquiry process, students are trained to choose a self evaluation and self reflexion, which is a product of the process of inquiry and permitting success at each stage.

B. Using Technology in Inquiry Based Learning

The rapid development of computer technology and communication brings also bring development and change in people's lives. It is not least also affect the role of technology in the development of education. In the education sector of education, the computer is a multi-functional tool that can be used in teaching and learning. Furthermore, the computer helps in distinguishing the role of students and teachers, apply the same standards of learning [6]. Software can also equate education and encourage student understanding and meaningful learning for all students in a constructivist approach. Teacher-centered learning spontaneously become student-centered when the atmosphere multiple intelligence implemented in educational activities through the use of computers [7].

As in other areas of life, the use of computers in mathematics learning is growing by leaps and bounds. However, the characteristics of users and many other variables that describe various types of use of technology in learning mathematics. At first, teachers and educational researchers think that kompuetr is a support tool in learning as well as priyektor screen, slide or television. Computer applications used initially only used to present the electronic pages with colorful pictures and simple calculations compared to computer role in guiding students to construct their own knowledge [6]. If the computer is only used traditionally, for example for a simple calculation, then it will give a bad impact on the results to be achieved in learning. Traditional computer usage, for example, according to Nocliffe [8], when the computer is used as a calculator in learning algebra, where students can only see the results with a simple calculation. The results show that students lose their ability in algebra calculations when they only use the computer as a simple calculation tool.

In the era of today's educational progress, many teachers and lecturers who incorporate technology into the classroom. In better teaching of mathematics, the use of technology in the classroom to make high-level math activities can be more easily accessible to students. In this case, the technology can strengthen students' learning process, by presenting the content of numerical, graphical, and symbolic without spending time to calculate complex computing problems manually. Technology can also help to encourage students acquire skills and abilities to make connections between concepts so finding solusinyai and proven process pengerjaannnya [9]. This technology can also help students to make connections between mathematics with real contexts outside of mathematics to make the learning process more realistic in the context of [9].

According to Okur, et al [6], one of the significant challenges in mathematics teaching and learning is how to teach students about abstract concepts. In this case, technology in mathematics learning software can be used more broadly to instill abstract concepts in mathematics. With the software mathematical some materials that are difficult to explain, it can be more easily delivered to students. In addition, according [10] the technology can also be used for troubleshooting, eg in advanced calculus courses, students often have difficulty in determining a region integral to the integral llipat three. With the use of software Maple in learning, the student's difficulties can be overcome, so that students can more easily determine sketches, regional integration and function integration.

The use of technology in learning mathematics in general aims to assist students in learning, such as helping students understand the concept, invented the concept, oenguatan concept, and as a means to train thinking in problem solving. There are several role of the use of computer technology in learning, is as follows [10]:

1. Technology as a tutorial for students, which means that the technology used for materitertentu menyampaiakn or explain to the students and the material is presented in a computer.
2. Technology as drill and practice, which means that the technology can be used untukmenguji level of knowledge or understanding of the students after learning of the material.
3. Technology as simulations in learning, which means that the technology can be used to demonstrate or demonstrate an idea or concept.
4. Technology as a tool or media in learning because it has the nature of trial and error to solve a problem.
5. Technology can be used in problem solving.

According to Justice et al (2002), inquiry learning process is a cycle in which the students are involved in a topic, develop a question to be explored, determine what information is necessary, collect data, synthesize inventions, discoveries and evaluate the immediate success communicate the inquiry process, students are trained to choose a self evaluation and self reflexion, which is a product of the process of inquiry and permitting success at each stage.

The use of technology in the inquiry can be done when students explore the necessary information, collecting data and synthesize its findings or evaluating the results obtained and communicate it to classmates. In addition, when there is a mathematical problem that is presented to the students, then the students can also use the technology for solving the problem. For example, in advanced calculus courses, students usually have difficulty in determining the regional integration of the triple integral. The role of technology in this case, for example in the form of Maple Software which is one of the software in mathematics, which is to sketch the graph, so that students easily determine the area of integration and determine the shape of the function to be integrated. By using inquiry learning that utilizes the aid of computers, the students are trained to capture information from maple software in the form of a chart to determine the area of integration. At the stage of communicating the results, students can display the answer that has been gained by using software (eg, displaying graphs and calculation results) or you may also use powerpoin. Thus, the integration of technology in inquiry based learning in mathematics is expected to generate a deeper understanding and flexible in accordance with the development of education that can't be separated from the development of technology.

III. CONCLUSSION

There are several conclusions that can be drawn from the above description, is as follows:

1. One of the significant challenges in mathematics teaching and learning is how to teach students about abstract concepts. In this case, technology in mathematics learning software can be used more broadly to instill abstract concepts in mathematics. With the software mathematical some materials that are difficult to explain, it can be more easily delivered to students.
2. There are several role of the use of computer technology in learning: Technology as a tutorial for students, Technology as drill and practice, Technology as simulations in learning, Technology as a tool or media in learning because it has the nature of trial and error to solve a problem and Technology can be used in problem solving.
3. inquiry learning process is a cycle in which the students are involved in a topic, develop a question to be explored, determine what information is necessary, collect data, synthesize inventions, discoveries and evaluate the immediate success communicate the inquiry process, students are trained to choose a self evaluation and self reflexion, which is a product of the process of inquiry and permitting success at each stage
4. The use of technology in the inquiry can be done when students explore the necessary information, collecting data and synthesize its findings or evaluating the results obtained and communicate it to classmates. In addition, when there is a mathematical problem that is presented to the students, then the students can also use the technology for problem solving.
5. the integration of technology in inquiry based learning in mathematics is expected to generate a deeper understanding and flexible in accordance with the development of education that can't be separated from the development of technology.

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ME – 44

Characterization of Spontaneous Examples Based on Teacher and Student Thinking Interaction in Mathematics Learning

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Abstract— When the teachers teach the material in course of study, teacher must be master the subject matter that will be given to students. And when the student will determine concepts that will constructed of material being taught by teachers, students can interact with the teacher to solve a problem, then student will communicating about its opinions so that students find the right solution. At the this interaction activity are among of teachers and students going on interaction process thinking in solving the problems appropriately. This research investigated the characteristics of spontaneous example through thinking interaction of teachers and students in the learning of mathematics. Spontaneous example is an example of is modified or produced by teachers spontaneously. In that case this, how the thought processes the teacher and students to the thinking processes generated spontaneous example and explained by the teacher in course of study of mathematics. The main objective in this study was to assess the characteristics of spontaneous example by thinking interaction Teacher and Student in the learning of mathematics. The results of the research shows that by the thinking interaction of teachers and students in spontaneous example in the mathematics, has produced characteristics of spontaneous example illustrations. In an illustrative example spontaneous consist of 3 (three), namely: (1) simple; (2) equivalent; and (3) expansion (expansive)

Keywords: *thinking interaction, spontaneous example , and mathematics learning*

I. INTRODUCTION

In learning activities are teacher interaction with students that involves thinking of students. This interaction should not rule out the thinking of students. This is due to the thinking of students will determine the form of a concept built by students during the learning activities. Therefore, in the learning of teachers should also pay attention to the thinking of students being able to determine a concept that will be built during the students' learning activities. When the concept was built by students in accordance with the material being studied, the learning objectives have been achieved.

Some research results emphasize the importance interaction in the learning process of mathematics (Elbers, 2003; Steinbring, 2005; Nührenbörger & Steinbring, 2009; Tucker & Harden, 2012). According to Webb (Nührenbörger & Steinbring, 2009) that the interaction of students with regard to solving the problem through the example influential on the results studying mathematics. Nevertheless, the interaction of teachers and students in mathematics, especially the thinking interaction Teacher-Student in learning of mathematics is still less attention.

Thinking interaction in mathematics instruction, as described above, has a great potential to improve student achievement. It is therefore, reforms should how to develop thinking interaction teacher-student in the learning of mathematics, so can be used to improve student achievement, particularly teacher-student thinking interaction associated with the use of examples in mathematics learning. Role of the process of thinking for teachers is to interpret and translate complex concepts to a level appropriate to the student learning experience. It is important that teachers must first develop an understanding of the material will be given to students. When teachers do not fully understand the material well then he will not be able to teach well (Lederman, et al, 2000). This becomes a serious problem when the concepts are incorrectly delivered to students as a result of a lack of understanding in-depth knowledge of teachers of subjects Sanders (Deborah et al, 2005)

Choose and produce examples in teaching, are often needed in the decision-making during an interaction of thinking in the classroom. In the interaction of thinking, the quality of mathematical knowledge of a teacher dijarkan affect what and how to teach. Zodik & Zaslavsky (2008) argued that knowledge of student learning refers to teachers' understanding of how students can know and how students can construct knowledge there is to gain new knowledge. Furthermore, Simon (1995) connects the teacher's knowledge, pre-planning instruction thinking, and interaction in the classroom that fact often hold spontaneous action. The spontaneous action leads to modification or construction of a new sample, which is often called spontaneous example.

Spontaneous sxamples of raised when students do not understand the material identified by the teacher, or when students make mistakes, or when students may discuss and occurs understanding different concepts, or perhaps when her students respond or claim the teacher's explanation. Zodiac & Zaslavsky (2008), suggests a spontaneous case of the example shown in situations where teachers have a clear plan for a lesson, but no specific examples.

However, the use of examples in mathematics learning, in particular the of spontaneous example still received less attention. As noted Zaslavsky (2011) that in spite of the important role the example in learning and teaching of mathematics, only a small number of research focuses on examples teacher selection and treatment exsample. Similarly, there has been no in-depth studies that reveal the interactions thinking teacher-student that focusing on of spontaneous example.

Questions and Purpose Research

The research question is how the characteristics of spontaneous example based thinking interaction teachers and students in mathematics learning ?. And the purpose of this study was to explores and characterization of spontaneous example based thinking interaction teachers and students in mathematics learning.

II. METHODOLOGY

A. Technique Data Collection

Procedure / stage of data collection is done as follows: (1) the preparation phase, researchers introduced various matters associated with the planned research, including research instruments to check the readiness and determination of research subjects, (2) the data collection phase during the learning process. All the learning process observed and recorded using audio-visual (handycam), well by the time teacher explaining or discuss examples the chalkboard or when the students pay attention to the teacher explanation.

B. Techniques Data Analysis

Data that has been collected and are still in the form the recording, then transformed into the shape of a transcript. Process data analysis in this research is a modification of qualitative research the needs analysis that was developed by Creswell (2010), with the steps as follows: (1) manage and prepare data to be analyzed, (2) read the whole data set, (3) analyzing greater detail with mengcoding a data, (4) decrypting a data, (5) the presentation of data within a narrative / qualitative reports and (6) to interpret or interpret the data.

III. RESEARCH RESULT

Teacher and student were become subjects in this study, will describe how the process of thinking interaction teachers and students in the process mathematics learning in the classroom. Teachers who become research subjects are Mathematics Teacher Junior High School country seven Makassar, while students were become research subjects are grade students of nine Junior High School country seven Makassar.

Teacher explains the material about the rank fraction, teacher implementing a method debriefing in course of study so the atmosphere of in the process learning make students more active. When Master give examples linked to material identified, teacher often refer some of the students for answering the example. Similarly, teacher many give examples (including examples of spontaneous) when explaining lesson material.

The following is presented results of thinking interaction between Master and students. Present was presented with a transcript of the recording process of learning mathematics in the rank of material fractions.

Teacher: Note the following properties, (write 1. $p^{\frac{m}{n}} = \sqrt[n]{p^m}$)

Teacher: What is below (showing n at the $p^{\frac{m}{n}}$) ascend to the rank of roots (pointing $\sqrt[n]{p^m}$) the above (pointing m the $p^{\frac{m}{n}}$) becomes rank number $\sqrt[n]{p^m}$

Teacher: It is nature of following (write down 2. $\sqrt[a]{p^b} = p^{\frac{b}{a}}$)

Teacher: (explaining example) Simplify: 1) $5^{\frac{2}{3}}$ 2) $9^{\frac{4}{5}}$ 3) $2^{\frac{2}{3}}$ 4) $\sqrt[4]{81}$

Teacher: Try Ismail mentioned that what you know of these numbers (Pointing $2^{\frac{2}{3}} = \sqrt{\quad}$), call a one!

Student/Ismail : (mention) 2 (two)

Teacher: (write down 2 at the $2^{\frac{2}{3}} = \sqrt{2}$), is called by Ismail

Teacher: (Designate Danial) mention one course

Student: (Danial mention), three sir!

Teacher: (write down 3 at the $\sqrt[3]{2}$)

Teacher: (Designate Sahra) mention, there still that need to written out? Appoint $2^{\frac{2}{3}} = \sqrt{2}$

Student: (Sahra paused and then mention) two !

Teacher: (write down 2 at the $\sqrt[3]{2^2}$)

Teacher: (Designate Sukmawati) Please you read, what reading this! (appoint $\sqrt[3]{2^2}$)

Student/Sukmawati : (mentions) three roots of two squared

Teacher: (Designate Fajar) Fajar could read? (appoint $\sqrt[3]{2^2}$)

Student / Fajar: (answer) forget sir!

Teacher: Well then, all the hear and look!

Teacher: This (pointing $\sqrt[3]{2^2}$) his reading, the cube root of two squared!

Teacher: This (pointing $\sqrt[5]{9^4}$) be parsed again!

Teacher: (writes = $\sqrt[5]{(3 \times 3)(3 \times 3)(3 \times 3)(3 \times 3)}$)

Teacher: Have a look here (pointing $\sqrt[5]{(3 \times 3)(3 \times 3)(3 \times 3)(3 \times 3)}$) all the, so that you understand!

Teacher: So the number 3 released one of (pointing $\sqrt[5]{(3 \times 3)(3 \times 3)(3 \times 3)(3 \times 3)}$) because pass one, whereas the rank 3 because his number was no escape as much 3

Teacher: Thus (write down 3 $\sqrt[5]{3^3}$) this is the simplest form

Student : From where 3 gained sir?

Teacher: Problem number 4 (write down $\sqrt[3]{81}$= $\sqrt[3]{(3x3x3x3)}$

Teacher: Why do not we outlined 9x9 ?, who knows?

Teacher: Because not immediately removed from the roots then we are outlined!

Teacher: Try (write down $\sqrt[3]{81} = \sqrt[3]{9x9}$), can be removed from its roots?

Student : No

Teacher: 81 = 9x9, 9x9 = 3x3x3x3

Teacher: So it $\sqrt[3]{81} = \sqrt[3]{3x3x3x3}$ (write down = 3 $\sqrt[3]{3}$)

Student : Sir, inquired Sir?

Teacher: Please

Student: If it's number 4 be a the rank fractional sir, such as the nature 2 described above, how to sir?

Teacher: explain by delivering some examples of different

The following stated structure thinking interaction teachers and students in the learning process of mathematics subject matter the rank fractional

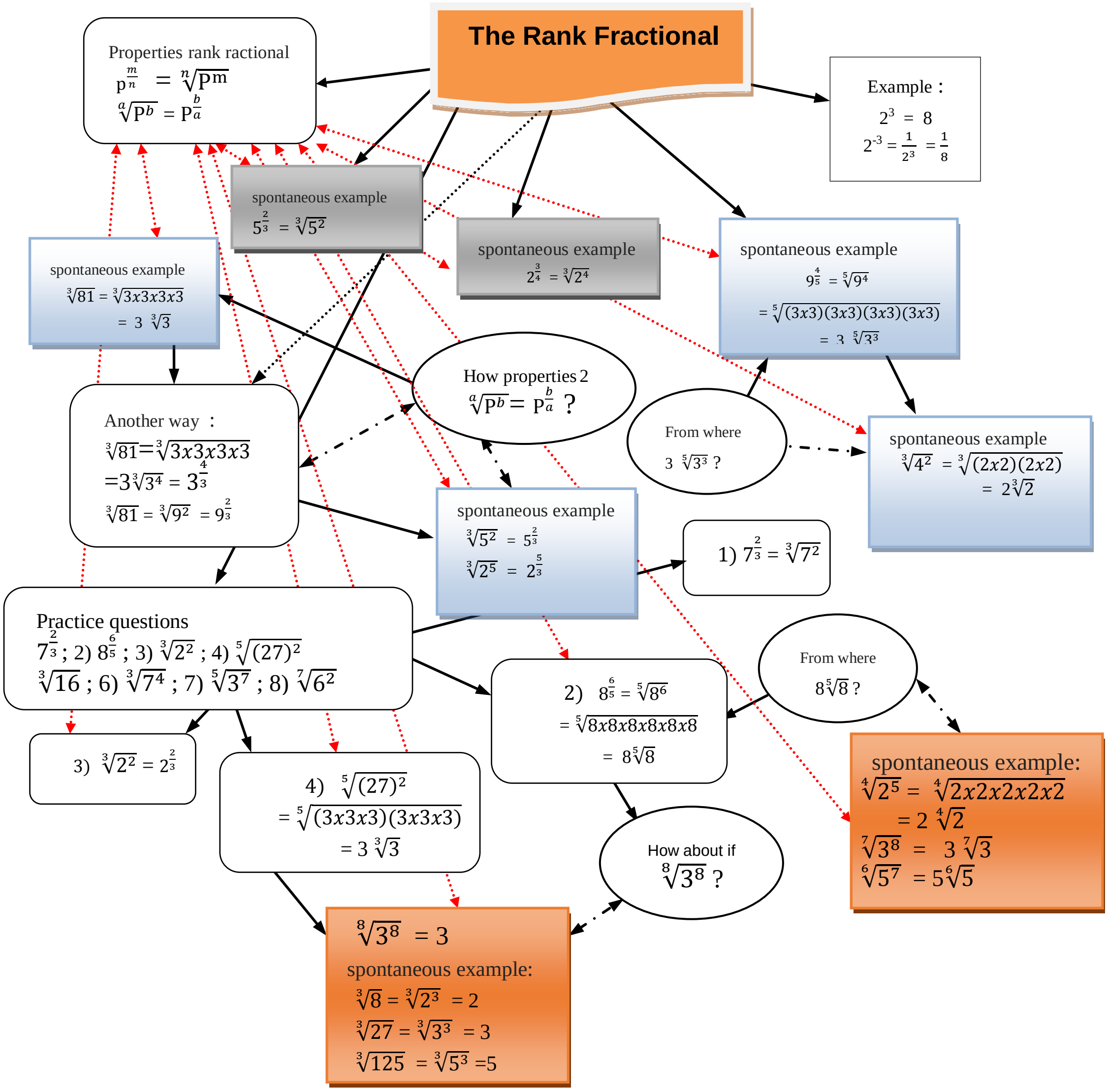

Diagram 2. Structure interaction thinking teacher and student in mathematics learning

Based on observations during the learning process in the classroom and diagram 2 above, teachers more often designate students to answer sample questions written by the teacher. Sometimes students who were not able to answer correctly because they trouble understanding the a concept the rank fraction. However, there are some students who are actively asking about the material identified by teachers. Students often different in mind with what was described by a teacher. So it felt not satisfied with the answers a teacher. This happens because the teacher did not explain in advance the meaning of the material being studied, but directly provide examples. And the examples are written not directly be explained, but it gives an opportunity (pointing) to the students to find the answers.

The thinking interaction between teachers and students at the time of the teacher gives some examples relating to the material the rank fraction. However, by the time teacher gives examples and then explain the example, sometimes students have of understanding or different ways, for example, when a teacher explain the examples do not like that is in the minds of students because answers from these examples do not like at the properties which force which has been described by previous teachers, so as to make students confused. Eg, the teacher gives an example $\sqrt[3]{81} = \sqrt[3]{3x3x3x3} = 3\sqrt[3]{3}$

In mind the student that ought answers some of these examples should be effective as of correspond to the the nature of or nature of powers of, or answers of the example its shape the rank fraction not cube root. Due to claim of one of his students, the teacher gives some examples the different. Spontaneous example such is an spontaneous example the illustrative its nature expansion of (expansive). Eg, the teacher wrote down another way, namely $\sqrt[3]{81} = \sqrt[3]{3x3x3x3} = 3\sqrt[3]{3} = 3^{4/3}$ Another possibility with writing down $\sqrt[3]{81} = \sqrt[3]{9^2} = 9^{2/3}$ (spontaneous example the illustrative that are simple). The teacher gives different example, namely $\sqrt[3]{5^2} = 5^{2/3}$ and $\sqrt[3]{2^5} = 2^{5/3}$. Then the teacher asked how to resolve if the cube root, cube root three were equal to the rank numbers is rooted, for example √ (8 & 3 ^ 8). Teachers give some examples the different based on the case raised by the student. Next, the teacher gives example spontaneous nature expansion of (expansive) as follows: a) $\sqrt[3]{8} = \sqrt[3]{2^3} = 2$, b) $\sqrt[3]{27} = \sqrt[3]{3^3} = 3$, and c) $\sqrt[3]{125} = \sqrt[3]{5^3} = 5$.

IV. DISCUSSION

In this study, 2 (two) characteristics spontaneous example in the learning process of mathematics. Two of these findings, namely klarifikatif and illustrative. However, in the presentation of illustrative appear spontaneous example in its nature: simple, equivalent, and expansion of (expansive). Clarification is spontaneous example settlement with classifies these examples, where teacher explains or review the completion of the sample. Illustrative is a spontaneous example by illustrating completion of these examples, where teacher explains and gives examples a different its nature is simple, equivalent, and expansion of (expansive). Spontaneous examples illustrative that its nature simple, the teacher gives some examples of more simple rather than previous example. Spontaneous examples illustrative its nature equivalent, the teacher gives several examples that equivalent the previous example. While the spontaneous examples its nature illustrative expansion, namely the teacher gives some example which is the expansion of some of previous example. In the presentation of the material the learning process mathematics in the classroom, teacher provide more spontaneous illustrative example. Examples given are examples that have arisen from the mind teacher spontaneously, then the teacher provides the spontaneous example illustrative its nature simple, equivalent, and expansion of (expansive).

Consideration teacher gives spontaneous example such, like example the rank fractions described above that begin with the rank positive or rank actual. Because it later when the they already know that 2^3 value is 8 then later on given 2^{-3} they will be confused, I say to the students that the rank of negative was converted into $^1/_?$. Then where the difference between 2^3 with 2^{-3} in integer with fractions. My commence not with the process, but the outcome, eg $2^{-2} = {}^1/_4$, $3^{-2} = {}^1/_9$. Similarly, that in presenting the examples I was begin with 2^3 instead of I began to 2^{-3}, possibly she was confused. Hence can be seen that the rank of positive outcome integers, but if the rank of negative numbers into fractions but there remains number 8. If I am developing further, eg 3^2 outcome 9, and 3^{-2} outcome $^1/_9$.

Use of many examples in the learning process is generally recognized to be important aspect and embedded most teaching mathematics (Atkinson et al, 2000; Bills et al, 2006; Carpenter, 1989; Mason, 2006; Stein et al, 1996; Zaslavsky, 2010; Zodik dan Zaslavsky, 2008). Examples are integral part of mathematical thought, learning and teaching, with particular regard to conceptualization, generalization, abstraction, argumentation and analogical thinking (Zodik dan Zaslavsky, 2008, hal. 165). Similarly, Bills et al (2006) argues that use of many examples inside have an impact of learning on the learner, ie have good reasoning and capability solving.

In the process of the thinking interaction in learning, according Vygotsky, there are two important principles in interactions (the thinking interaction), namely (1) regarding function and importance of language in social communication that begins the process of pencaderaan to sign until to exchange information and knowledge, and (2) Zone of Proximal Expansion (ZPD). Teachers as mediator has the role of and bridge the encourage students in their efforts build knowledge, understanding and competence. According the theory of Vygotsky, cognitive functions of humans derived from social interaction of each individual in a cultural context. Vygotsky also convinced that learning occurs moment students work handling tasks that have not be learnedhowever these tasks are still within range of capabilities namely the are within Zone of Proximal Expansion (ZPD) their. ZPD is the area between the actual expansion level which is defined as the ability solve problems independently with the level potential expansions were defined as problem solving skills under guidance of adults or their peers who are more capable.

V. Recommendation

In this research only limited to the certain areas of material, ie one subject (the rank fraction) in the field of algebra. It is therefore, as ingredients for expansion subsequent researchers were want to conduct research, relating to the thinking interaction of teachers and students in of spontaneous example learning of mathematics, should review or developing on the other subject matter on the field algebra or geometry fields.

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ME – 45

An Analysis of Problems on Eight Grade of Mathematics Textbook Based on PISA's Framework

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Abstract— One of the reasons of the implementation of new curricula is the low achievement of Indonesian student in international survey like PISA. To support the implementation of the new curricula, known as K-13, student's mathematics textbook was developed. The objective of research is to analyze suitability between the problems on eight grade of mathematics textbook and PISA's Framework as well as on content, process, and context. This study is descriptive qualitative research. The result of the research are that the contents of the textbook are in line with the PISA's framework although the 1st semester is dominated by change and relationship content, meanwhile the 2nd semester is dominated by space and shape content. The process in the textbook involve applying, reasoning, critical thinking, and problem solving. Meanwhile, the problems in the textbook are lack of scientific context. The problems are dominated by personal context.

Keywords: *critical thingking, mathematics literacy, mathematics textbook, PISA's Framework, and problem solving*

I. INTRODUCTION

In the manufacturing and agrarian economies that existed 50 years ago, it was enough to master reading, writing, and arithmetic. In the modern era, those competency aren't enough. According [1], If today's students want to compete in this global society, however, they must also be proficient communicators, creators, critical thinkers, and collaborators. On the other hand, in era information education must facilities to explore creativity, critical thinking, communications, and collaboration ('four Cs') for the students. Besides, the students also need additional competencies like language, arts, geography, sciences, and social studies. In the classroom, the teachers must be provides those additional skills in his teaching.

Focus to gives four Cs skills, mathematics teaching must elaborate aspects of creativity and innovation, critical thinking and problem solving, communication and collaboration [2]. Creativity and innovation aspect ask students use a wide range of techniques to create new and worthwhile ideas, elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts, and demonstrate originality and inventiveness, in both an individual as well as group settings. Meanwhile, critical thinking and problem solving aspects are intended students reason effectively, use systems thinking and understand how parts of a whole interact with each other. They make judgments, decisions and solve problems in both conventional and innovative ways. Moreover, communication and collaboration aspects meant students know how to articulate thoughts and ideas effectively using oral, written and nonverbal communication. They listen effectively to decipher meaning, such as knowledge, values, attitudes and intentions, and use communication for a wide range of purposes in diverse teams and environments. The three aspects of mathematics teaching be expected supporting mathematics literacy for the students.

According [3], mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens. OECD organize survey every three year through Program for International Student Assesment (PISA) to understand mathematical literacy. PISA survey conducted since 2000 is assessment of 15-year-old students, which in Indonesia usually on eight grades. The achievement of Indonesia students on PISA Survey are very low. In 2000, Indonesia student are on rank 39th of 41 countries, in 2003 on rank 38th of 40 countries, in 2006 on rank 50th of 57 countries, in 2009 on rank 61st of 65 countries, and in 2012 on rank 64th of 65 countries.

PISA Survey indicates that mathematical literacy of Indonesian students is on low level. Its mean that Indonesian students lack of creativity, innovation, and reasoning to solve a mathematics problems which are usually presented in real world context. Problems on PISA assesses mathematical literacy on three aspect, i.e. process, content, and context. Moreover [3] explain that mathematical process include (a) formulating situations mathematically; (b) employing mathematical concepts, facts, procedures, and reasoning; and (c) interpreting, applying and evaluating mathematical outcomes. Mathematical content include change and relationship, quantity, space and shape, and uncertainty and data. Meanwhile mathematical context include personal, occupation, public, and scientific.

One of the effort of Indonesian government, i.e. ministry of education and culture to increase student's achievement in international survey like PISA is developing new curricula, known as K-13. In K-13, mathematics curricula had major change. Elements of change in mathematics subject include: (a) start from concrete problems, semi-abstract, then abstract problems, (b) formula derived by students and the problems must be solved using basic formula and understanding, (c) balance between number, graph, figure, and pattern, (d) designed for critical thinking, (e) familiarize with algorithmic thinking, (f) extend of content about probability, data analysis, and statistics, and (g) introduce approach and estimate concepts. In new curricula K-13, mathematics subject attempted to give four Cs skills and to support mathematical literacy.

Developing new curricula needs a new book for delivery the subject, both teacher and student textbook. The quality of mathematical textbook which is used the students influence the quality of teaching. According [4] who studied about suitability between mathematical textbook grade tens and syllabus of K-13, indicate that 80,49% content of textbook are suitability to basic competencies, 95,83% are suitability to scientific approach, and 88,80% are suitability to authentic assessment. Meanwhile [5] who studied about analysis of problems on ten grade mathematics textbook K-13 using PISA framework indicate that number of problems which suitability with PISA framework are 44 problems (46,81%).

Paper addresses an analysis of problems on eight grade mathematical textbook. Paper would be describing the problems on mathematical textbook on the aspects of process, content, and context. Analysis of problems on the textbook focus on the practice problems and competency test on every chapter of the textbook.

II. RESEARCH METHOD

This study is descriptive qualitative research. Object of the research is mathematics textbook both semester 1st and semester 2nd which are published by Ministry of Education and Culture [6], [7]. Data was collected using observation and interview. Observation method is to analyze a problems using PISA's framework. Moreover, problems are classified into process, content, and context categories. Method of interview is complement to know about implementation of mathematics textbook in teaching. Interview done to both teacher and students. Analysis of data using procedure data reduction, data display, and make a conclusion.

III. RESULT AND DISCUSSION

Eight grade mathematics textbook for 1st semester consist 6 chapters and it contain 246 problems. Meanwhile, on the 2nd semester consist 6 chapters and it contain 239 problems. Based on PISA Frameworks, generally on content aspect, problems on textbook cover all of content i.e change and relationships, space and shape, quantity, and uncertainty and data. In Table 1, from the aspect content, problems on mathematics textbook dominated by change and relationships. The textbook for 1st semester dominated by change and relationships content amount of 55,28%, and quantity content is only 5,06%. Meanwhile, mathematics textbook for 2nd semester dominated by space and shape content amount of 41,42%, and uncertainty and data content is only 15,48%. In average, eight grade mathematics textbook is dominated by change and relationship content amount 45,36%.

Table 1. Classification of Mathematics Problems based on Content

Content	Semester I	Semester II	Average
1. Change and relationship	55,28%	35,14%	45,36%
2. Space and shape	33,73%	41,42%	37,52%
3. Quantity	5,06%	18,41%	12,16%
4. Uncertainty and Data	10,56%	15,48%	12,98%

There are some a good problems PISA-like on eight grade mathematics textbook. For example, on the 1st Semester, practice 5.3, problem number 1 as follow.

'*Tinggi sebuah jendela lantai 2 pada sebuah gedung kira-kira 8 meter. Di depan gedung tersebut ada sebuah taman dengan lebar 6 meter. Berapa panjang tangga minimum yang dibutuhkan agar kaki-kaki tangga tidak merusak taman tersebut*?' (Height of the window on the

2nd floor of a building is about 8 meters. In the front of the building, there is a garden which have 6 meters in width. If someone want to reach the window using ladder, how many minimum length of the ladder so that foot of the ladder can't damage the garden?'

Content of the problem is space and shape. The problem associated to plane geometry, i.e. right triangle especially Pythagorean Theorem. The students be expected have capability to represent some object, i.e. ladder, walls, and the garden which are form like a right triangle. By using phytagorean theorem, the students be expected to solve the problem.

According the mathematical process, the problem above can be classified into employing mathematical concepts, facts, procedures, and reasoning. To solve the problems, the student must be able to: (a) make a design and implement the strategy to discover a solution, (b) apply a mathematical fact, rule, algorithm, and mathematical structure, (c) manipulate a number and represent a geometry, (d) explore of information and make mathematical construction, (e) use and switch among different representation of the object, and (f) make a generalization based on mathematical procedure to get a solution.

Table 2. Classification of Mathematics Problems based on Process

Process	Semester I	Semester II	Average
1. formulating situations mathematically	35,77%	17,57%	26,80%
2. employing mathematical concepts, facts, procedures, and reasoning	63,01%	69,45%	66,18%
3. interpreting, applying and evaluating mathematical outcomes	15,04%	22,17%	18,55%

Analysis of mathematical process, most of the problems on eight grade mathematics textbook focus on employing mathematical concepts, facts, procedures, and reasoning. On Table 2 can be observed that the process of employing mathematical concepts, facts, procedures, and reasoning both the 1st semester and 2nd semester are more dominant, i.e. amount of 63,01% and 69,45% respectively. Meanwhile the process of interpreting, applying and evaluating mathematical outcomes on the 1st semester is very low compare to the others process, that is 15,04%. Moreover, the process of formulating situations mathematically on the 2nd semester is only 17,57%. Generally, the mathematical process of employing mathematical concepts, facts, procedures, and reasoning is more dominant compare to the other process, i.e amount of 66,18%. The process in the textbook involve applying, reasoning, critical thinking, and problem solving.

Table 3. Classification of Mathematics Problems based on Context

Process	Semester I	Semester II	Average
1. personal	8,9%	26,35%	17,52%
2. occupation	4,87%	7,94%	6,39%
3. public	8,13%	5,02%	6,59%
4. scientific	2,43%	3,34%	2,88%

In mathematical context, the problems on eight grade mathematics textbook indicate that personal context is more dominant. Table 3 shows that both on the 1st semester and the 2nd semester personal context amount of 8,9% and 26,3% respectively. Conversely, the problems is lack on scientific context, on the 1st semester and the 2nd semester are 2,43% and 3,34% respectively. Generally, mathematical context dominated by personal context that is 17,52%. Although the personal context is dominant, some problems on occupation context began to introduce which is not limited in trading or marketing problems. For example, on the mathematics textbook 2nd semester, chapter 6 on competency test 6, problem number 14 as follow.

'*Kalian adalah manajer Timnas U-16. Suatu ketika Timnas bertanding di final fiala Asia melawan Malaysia. Suatu ketika saat pertandingan sedang berjalan, pada menit ke 89 Timnas mendapatkan hadiah penalty. Skor sementara adalag 2 – 2. Pemain yang siap menendang adalah Evan Dimas, Ilham, Maldini, dan Muchlis. Seandainya kalian disuruh menentukan penendang penalty tersebut, siapakah yang akan kalian tunjuk agar Timnas meraih kemenangan? Berikut catatan tendangan penalty keempat pemain tersebut*.

Name	Penalty (times)	Goal	block or caught by keeper	Out of the target
Evan Dimas	20	16	2	2
Ilham	18	14	2	2
Maldini	17	12	4	1
Muchlis	15	11	3	1

The problem above can be classified into occupational context, i.e. as manager of national team. Manager want to select the best player to take penalty kick so that the national team become the winner. Content of the problem above is uncertainty and data. In this case, data display about penalty kick of the players. The mathematical process of the problem above is about formulating situations mathematically. In this case, the students ask to identify mathematical aspects of the problems on real context world. Moreover, the student also ask to: identify a variables that associated to the problem, simply the situation or problem, represent the problem in different ways, organize the problem into mathematical concepts and make new assumption, and identify mathematical facts or procedure to solve the problem.

If the objective of the problems on mathematics textbook is to increase mathematical literacy, generally number of problems PISA-like are still need to be added. Table 4 shows that the problems on eight grade mathematical textbook are lack of the problems PISA-like, i.e amount of 24,39% and 42,47% on 1st semester and 2nd semester respectively. Averagely, the number of problems which PISA-like are amount of 33,4%. Consequently, the problems on eight grade mathematics textbook aren't supporting yet the students to gain PISA standard.

Table 4. Recapitulation of Mathematics Problems

Problems	Semester I	Semester II	Average
Mathematics problems with content, process, and context like PISA	24,39%	42,47%	33,40%

The research result is in line with [5] i.e. the problems PISA-like on ten grade mathematics textbook is less than the problems non PISA-like. Meanwhile, the problems PISA-like on eight grade mathematics textbook are amount of 33,4%. Therefore, the problems both on eight grade and ten grade mathematics textbook aren't supporting yet the students become mathematical literacy.

The students argue that the problems PISA-like are more difficult than the problem non PISA-like. Generally, the student have an error to understand about significance and instruction of the problems. This is similar [6], error to understand about task, instruction, key information of the problems lead to mistake to solve the problems. The problems PISA-like ask the students to make a reasoning. Contrary, the students usually unfamiliar with the problems PISA-like. According to the teacher, all of aspects on PISA frameworks are included on eight grade mathematics textbook. Observing on mathematics teaching, the teacher isn't giving yet the problems PISA-like. Meanwhile, the mathematics textbook for K-13 is an effort of Ministry of Education and Culture to improve quality of education, especially in mathematics subject. The involvement of Indonesia on PISA survey is part to observe the development of educational program [9].

IV. CONCLUSION

The result of research indicate that the problems on eight grade mathematics textbook consist of all of aspect of PISA Frameworks, i.e mathematical process, content, and context. Mathematical process include formulating situations mathematically; employing mathematical concepts, facts, procedures, and reasoning; and interpreting, applying and evaluating mathematical outcomes. Mathematical content include change and relationship, quantity, space and shape, and uncertainty and data. Meanwhile mathematical context include personal, occupation, public, and scientific. Averagely, the problems on eight grade mathematical textbook that in line with PISA Framework is still low. The process in the textbook involve applying, reasoning, critical thinking, and problem solving. The content of the problems on mathematics text book dominated by change and relationships. Meanwhile the context of the problems on the textbook dominated by personal context.

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The Use of Problem Based Learning to Improve Higher Order Thinking Skills in Junior Secondary School

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Abstract— The purpose of this article is to describe enhancement of higher order thinking skills in mathematics instruction by using problem based learning model. Higher order thinking skills is the skills in resolving problems in new situations by using knowledge that include critical thinking, creative thinking, and problem solving skills. Indicators of critical thinking skills include the ability to analyze information, the ability hypothesize, and the ability to evaluate and reflect. Indicators of creative thinking skills include the ability to create new ideas, the ability to create new alternatives, and the ability to reflect. Indicators of problem solving skills include the ability to analyze, conceptual and procedural knowledge. Problem based learning is an instructional model that is centered on the student in the learning process where students are presented a variety of real problems or not structured to motivate students to learn and engage students in the greater understanding. The syntax use include present the problems, planning resolution of problems, implementation of planning, presentation, and evaluation.

Keywrds: *problem based learning, higher order thinking skills, mathematics instruction*

I. INTRODUCTION

A. Background

Mathematics is a universal science for underlies the development of modern technology, have an important role in a variety of disciplines, and promote the power of human. Putting mathematics as a subject can to understand, fun, and exciting of course is not easy. Fact in the field of mathematics lessons for students, especially Junior Secondary School is not subject demand because it is considered difficult and boring. Student difficulties in mathematics caused by several things such as the ability to think not yet high, the instruction less than innovative, so are students reluctant to higher think. Memorizing culture is still often done to make students' skills in thinking does not lead to higher order thinking skills. Then, in efforts to solve math problems, students have not been able to explore their thinking to be more critical and creative. Of course it is a high order thinking skills is required. [1]*Higher Order Thinking* a process to think critically and creatively, which in turn can be used by students in completing activities. To overcome some of these factors, we need a innovation in instruction and the willingness of students to change their of thinking to higher order think. Innovation in instruction can be applying with mathematical models of learning more than exciting, innovative, and make students more active in the learning process. Model of instruction is appropriate to the learning objectives to be achieved will make the learning process more fun. *Problem Based Learning* is a learning model can be encourages students to get involved in the learning process. Instruction with problem based learning usually begin with giving problems to the students, so the students can explore the provision of knowledge and develop it to obtain a solution. It certainly can affect the thinking of students in finding solutions to the real problems with the ability to think critically and creatively, so can be promote Higher Order Thinking Skills. [2] The application of the model PBL influences the ability to problem-solving skills. [3]The students can use the problem-solving skills to explore the problems and determine the next syntax. Based on this background shows that the high order thinking skills is important in mathematics, so in this article will discuss the use of Problem

Based Learning to improve Higher Order Thinking Skills in Junior Secondary School.

B. Problem formulation

1. How the use of problem based learning to improve higher order thinking skills?

C. Purpose

1. To describe enhancement of higher order thinking skills in mathematics instruction by using problem based learning model.

D. Benefits

The benefits of this article is to know the importance of high order thinking skills in mathematics instruction. Use of problem based learning models in an effort to improve high order thinking skills effectively in accordance with the existing theory study, so it can be used by teachers and researchers as a benchmark in reviewing the theory so as to assist in innovation instruction and research conducted.

II. KAJIAN TEORI

A. Problem Based Learning (PBL)

1. Definition of Problem Based Learning (PBL)

The learning model is an important element in the learning process, where the presence of a model of learning in the learning process becomes more meaningfully and objectives of the learning will be achieved as desired. [4] Problem based learning is an approach to learning that is characterized by flexibility and diversity that can be applied in various ways and in subjects and different discipline and in diverse contexts as well. Difference and diversity issues that would later be able to motivate the students to solve a problem. [5] The problem-based learning approach, in complex real problems used to motivate students in identifying and researching concepts and principles are needed in working through these problems. [7]Problem Based Learning is recognized as a progressive active learning and student-centered, where the problem of unstructured used as a starting point in the learning process. In addition PBL is an instructional model that is very good for developing critical thinking skills. [8] The problem-based learning is a student-centered approach ynag governing curriculum and learning activities using unstructured problems and problems in the real world. Based on the above definition dapaat some concluded that Problem Based Learning (PBL) is a student-centered learning in which the learning process of students presented a variety of real problems or not structured to motivate students to learn and engage students kepemahaman larger.

2. Characteristics of Problem-based Learning (PBL)

Problem-based learning is based on problem situations confusing and unclear can arouse the curiosity of students and engage students in the inquiry. [8] Characteristics of PBL into six covering the problem as early learning, authentic, investigation and problem solving, interdisciplinary perspective, small group collaboration, and the results and presentation. [6] Problem Based Learning in the curriculum mempuanyai some of the following characteristics: (1) a problem as the starting point of learning, (2) the problem is a real world problem that is unstructured, (3) problems as various perspectives, (4) problems as challenges of knowledge, attitudes and competencies students to identify learning needs and new places of learning, (5) give priority to self-directed learning, (6) utilize various sources of knowledge, use and evaluate information, (7) learning is collaborative, communicative and cooperative, (8) the development of the investigation and problem solving skills ssangat important in determining the solution of the existing problems, (9) the cover in PBL consists of synthesis and integration pemeblajaran, (10) the closure on the process of PBL include evaluation and review the experience of learners and the learning process. [4] Characteristics of PBL are (1) the complex, the fact that there is only one correct answer which is the focus of the organization for learning, (2) the students work in tims to resolve the problem, identify gaps to learn and to develop viable solutions ,

(3) students received new information although learning by myself, (4) the teacher acts as a facilitator, (5) the problem leads to the clinical development of problem-solving abilities. Based bebrapa these opinions can be summed up the characteristics of the model problem based learning includes (1) a real problem as tititk early learning, (2) students as a group seeking solutions to problems real realistic, (3) the problem must be meaningful and it can be a challenge for students to find something the new, (4) students acquire new information to learn on their own as well as from a variety of sources of knowledge, (5) the teacher as facilitator, (6) use of the time, information, amenities are there to get troubleshooting solutions, (7) the students predicted to produce products and present it.

3. Syntax of Problem Based Learning

The purpose of Problem Based Learning is acquiring skills and problem-solving process. [6] Syntax in problem solving is to perform (1) the initial analysis, (2) the development of learning issues, (3) iteration of independent and collaborative problem solving, (4) the integration of new knowledge. Furthermore, students can evaluate and present the solutions obtained. [8]Something similar there are six stages in the model problem based learning that is giving problems, make the stages of problem solving, discovery troubleshooting solutions, assessment of the results of problem solving, presenting the resulting solution, and evaluate. The two theories previously put forward stages in the learning model of problem-based learning begins with administration problems, as well as the opinion by [7] namely (1) the presentation of the problem, (2) planning problem solving, (3) to carry out planning, (4) peyajian issues, and (5) reflection and debriefing. Based on expert opinion can be said to be the stages of learning problems can help students in higher-level thinking. Step-by-step problem-based learning in accordance with efforts to increase higher order thinking skills, namely (1) Presentation of the problem, be used as a starting point for learning sehinggadapat lead students to think critically, (2) planning problem solving, (3) the settlement of the problem, (4) presented the results, and (5) evaluate.

4. Excess problem based learning

The learning model used in the classroom learning process will affect the achievement of learning objectives sertaprestasi student learning. problem based learning has several advantages including: (1) PBL can provide a solid understanding of the basic knowledge-factual and apply; (2) provide opportunities for the development of critical appraisal skills; (3) the environment encourages students to ask questions; and (4) PBL allows students to create their own learning, becoming the basis for professional behavior in the future. It is also stated by [8] that is associated with the real world, encouraging students to learn actively, encouraging the birth of a variety of approaches to learning in an interdisciplinary manner, giving students the opportunity to choose what and how to be learned, encourage the creation of collaborative learning, and improve the quality of education. Based on the opinion of the experts put forward a model of problem based learning is an instructional model that is appropriate in order to increase high-level thinking skills of students in mathematics. Model problem based learning where students focus on learning in the learning process of students presented a variety of real problems or not structured to motivate students to learn and engage students kepemahaman larger.

B. Higher Order Thinking Skills (HOTS)

1. Definisi dan Indikator Higher Order Thinking Skills (HOTS)

Thinking is the cognitive skills to acquire knowledge. The ability to think can be defined as the cognitive processes that segregated into concrete steps that are then used as a guideline thought. Results in cognitive thinking can be seen from the high-level thinking skills HOTS identified using cognitive taxonomy. [9] Cognitive taxonomies are organized schemes for classifying instructional learning targets into various levels of complexity. Furthermore [9]defines the Higher Order Thinking into three categories yanitu, (1) Reviews those that define higher-order thinking in terms of the transfer, (2) Reviews those that define it in terms of critical thinking, and (3) Reviews those that define it in terms of problem solving. In line with [10] A clear and comprehensive, definition of higher order thinking has the potential to help educators transcend the split between the sciences" problem solving "and the humanities'" critical thinking. ". [1] the higher order thinking skills (HOTS) is divided into two components, critical thinking and creative thinking. Based on the opinion of some experts, we can conclude that HOTS is an ability in resolving problems in new situations by using knowledge. Such capabilities are critical thinking, creativity and the ability pemaecahan problem which is an indicator of high-level thinking skills. The explanation of these three indicators as follows.

a. Critical Thinking

Critical thinking skills is one of the high-level thinking skills that requires students be conscientious and finish a problem or give an opinion. [10]critical thinking abilities are specific cognitive skills that are used when a students exhibits critical behavior". Also according to [11] critical thinking is "reasonable, reflective thinking that is focused on desiding what to believe or do". Furthermore, the proposed [9] which explains that "as many of our readers know, critical thinking focuses on thinking that is reflective and that is directed toward analyzing particular arguments, recognizing fallacies and biases, and reaching Conclusions based on evidence and sound judgment ". Meanwhile, according to [12] argues that "critical thinking is thinking that examines, relates, and evaluates all aspect of the situation or problem. It include gathering, organizing, remembering, and analyzing information. Critical thinking includes the ability to read with understanding and to identity and Necessary extraneous material ". Based on the opinion of several experts can be concluded that critical thinking is a process of reflective thinking to decide what is credible and conducted in accordance with the information accompanied by evidence and good judgment. Indicators of critical thinking is.

1) *Analyzing information*
Collecting and analyzing relevant information on the situation and problems

2) Examines
Decisive step will be carried out according to the analysis of the information and the existing problems.

3) *Reflection and evaluation*
Explain the relevance of existing information, make inferences based on information and good judgment.

2. *Creative thinking*

Similarly, critical thinking, part of HOTS the other is where the critical thinking skills required in this kekmampuan ability to develop problem solving solution and find new solutions to a problem. According to [7] creative thinking is another type of thinking is of interest to educators. This type of thinking is normally associated with cognitive skills and abilities for coming up with novel solutions to problem situations. [9] characteristics of critical thinking is grounded (reasonable), yield (productivity), nonevaluatif, and touch (reflective). [7]creative thinking that is original and reflective thinking and that produces a complex product. According to some opinions can be concluded that creative thinking is a thought process that is original by using the capabilities to menciptkaan new ideas more meaningful. Thus it can be arranged indicators creative thinking as follows.

a. Cogent /reasonable
Combining ideas and use them appropriately in solving a problem

b. Productivity
Make or elaborated new alternative to mrnyelesaiakan a problem.

c. Reflection
Explain the relevance of the steps used in solving problems with information and ideas.

3. Problem solving skills

Before defining the problem solving, the first is to understand what was the problem. [9] Students incur a problem when they want to reach a specific outcome or goal but does not automatically Recognize the proper path or solution to use to reach it. [12] Problem solving is the application of Several rules to a problem not encountered before by the learner. Problem solving does not usually begin with a clear statement of the problem; rather, most problems must be identified in the environment; then they must be defined and represented mentally . [13] there are several indicators that the mathematical problem solving abilities.

1) identify the elements that are known, were asked, and the adequacy of the required elements;
2) formulate a mathematical problem or to develop a mathematical model;
3) implement strategies to solve a variety of problems (similar and new problems) inside or outside of mathematics;
4) explain or interpret the results according the problem of origin;
5) make the conclusion.

Based on some of the above opinion can be concluded that the problem-solving ability is one upon ability to solve a problem by using knowledge. Thus it can be arranged indicator problem solving skills as follows.

1) Analyze (Analyzing)

Menganalasis issue aims to sisiwa can determine the point of the problem, and write it in the form of a symbol so it will be easier for students to determine the steps to be used for resolving the problem.

2) Knowledge koneptual

Conceptual knowledge to assist students in understanding the problems and finding information to create strategies / measures to be used. Conceptual knowledge related to the situation of the problem, the information relefant, mathematical concepts and nature of logic.

3) Knowledge of procedural

Procedural knowledge related to the ability sisiwa in demonstrating measures / strategies used in accordance with the mathematical concept or model that is used in accordance with the problems.

III. CONCLUSION /INFERENCE

Based on the above discussion, the conclusion that can be drawn menganai how the problem based learning can improve HOTS is to see steps PBL models in an effort to improve HOTS tailored to the characteristics, namely PBL.

1. Presentation of the problem as early learning
2. Planning troubleshooting
3. Application design problem solving
4. Presentation
5. Evaluation and debriefing.

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Integrating Maratib Qira'ah Al-Qur'an and Marzano's Taxonomy to Provides Learning Objectives in Mathematics

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Abstract: This research is a development research, which aims to develop a new taxonomy theoretically by integrating *marâtib qirâ'ah al-Qur'an* and Marzano's taxonomy. This integration produces a concept about the classification of learning objectives which more comprehensive, including the description of integration result and the indication of learning achievement in all levels of integration result. In addition, this research provides examples of its application in formulating mathematics learning objectives. The research data were obtained from the result of literature study and interviewed to the expert of Arabic and Qur'an Education. Data were analyzed as a material to formulate the draft of integration result. The drafts were discussed with the expert of Qur'an Education and the lecturer of Mathematics Education in a sustainable manner to obtain a logical and accountable result. The results shows that the integration between *marâtib qirâ'ah al-Qur'an* and Marzano's taxonomy produces 5 new levels in the classification of learning objectives. These classifications include: 1) Retrieving knowledge (Integration of *talaffuẓ* and retrieval); 2) Comprehending knowledge (Integration of *tafahhum* and comprehension); 3) Analyzing knowledge (Integration of *tadabbur* and analysis); 4) Utilizing knowledge (Integration of *tafakkur* and knowledge utilization); and 5) System of self-control (Integration of *takhassyu*', metacognitive system, and self-system).

Keywords: *marâtib qirâ'ah al-Qur'an, Marzano's taxonomy, and learning objectives*.

I. INTRODUCTION

Mathematics learning is a very important thing in the world of education. The importance of mathematics learning can not be separated from the role of mathematics in all aspects of life. However, the world notes that the mathematics education in Indonesia is far from perfect. It is proven from the acquisition of Indonesia in TIMSS 2011 which showed that the mathematical ability of Indonesian students is at level 36 of the 48 participant countries. That achievement was even relatively worse in PISA 2012, which puts Indonesia on the 2nd lowest rank of the 65 sample countries, ie only one rank higher than Peru. Considering the importance of mathematics, and also a variety of problems that arise in mathematics education in Indonesia, arises a question how should mathematics learning in schools be organized so that mathematics can be mastered by students well?

Kamol & Ban Har [1] states that in order to improve students' learning in mathematics, it is necessary to understand the developmental mode of their thinking and reasoning. Learning is planned based on the needs and characteristics of students and directed to the changing of students' behavior according to the objectives will be achieved [2]. In addition, in order to support the implementation of mathematics learning in schools, it should be structured the concept of mathematics curriculum used clearly and in focused [3]. Thus, in order to make mathematics learning in school run well, the teacher must design a learning process with clear directions and learning objectives.

Considering the importance of learning objectives in mathematics learning, it is required the guidelines to formulate appropriate learning objectives for teachers. For this purpose, some experts have classified the learning objectives in a model called education taxonomy. One of education taxonomy that is often used is Bloom's Taxonomy.

Bloom's taxonomy divides the learning objectives into three aspects, namely cognitive, affective, and psychomotor. But in reality, the learning objective that is often highlighted by teacher is only cognitive aspect, while other aspects are not integrated in the learning, whereas in completing a task or problem, it is not only the cognitive aspect that plays a role.

Marzano & Kendall tried to answer the issues of Bloom's taxonomy by establishing a new model of taxonomy, i.e Marzano's Taxonomy. This taxonomy answered the limitations of Bloom's taxonomy. Marzano & Kendall developed a model of taxonomy that combines the wide range factors that affect on how students think [4]. Marzano's taxonomy model contains three mental system: self-system, metacognitive system, and cognitive systems. The fourth component of this model is domain of knowledge.

The self-system includes a network of beliefs and goals that are interconnected which is used to make decisions about the appropriateness of involvement in a task. The metacognitive system is responsible for making purposes related to new tasks and designing strategies to achieve goals that have been made. The cognitive system is responsible for processing information effectively for the completion of tasks. The cognitive system has four levels, namely retrieval, comprehension, analysis, and knowledge utilization. These three systems require domain of knowledge that will affect the success of students in facing every task. Simply, the model of Marzano's taxonomy is stages in thinking and learning that is begun with remember, comprehend, analyze, and utilize the knowledge gained by using prior knowledge.

Actually, the stages in Marzano's taxonomy had been taught by the Prophet Muhammad SAW in interacting with al-Qur'an. As said by Sahabah that "We do not pass without even one verse with the Prophet unless we read, memorize, understand, and implement it" [5].

The Prophet has pointed out how he had a complete interaction with al-Qur'an, start from pronouncing, memorizing, contemplating and also implementing al-Qur'an. Similarly, in teaching of al-Qur'an, the Prophet always prioritized aspects of memorizing, understanding, and implementation as mentioned in an *atsar* of Abu 'Abd al-Rahman al-Sulami. He said:

> حَدَّثَنَا مَنْ كَانَ يُقْرِئُنَا مِنْ أَصْحَابِ رَسُولِ اللَّهِ - صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ -أَنَّهُمْ كَانُوا يَأْخُذُونَ مِنْ رَسُولِ اللَّهِ - صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ - عَشْرَ آيَاتٍ, فَلاَ يَأْخُذُونَ فِي الْعَشْرِ الْأُخْرَى حَتَّى يَعْلَمُوا مَا فِي هَذِهِ مِنَ الْعِلْمِ وَالْعَمَلِ. قَالَ: فَيُعَلِّمُنَا الْعِلْمَ وَالْعَمَلَ [6].
>
> Had met me people who have read al-Qur'an at us from Sahabah of the Prophet Muhammad SAW, that if they learn ten verses from the Prophet, they did not continue the ten verses later until they know the knowledge and implementation. They said: We learn the knowledge and implementation all at once.

Fahmi Jiwanto Islam, a prominent Islamic education, has described the stages of the Prophet in interacting with al-Qur'an above into a theory called *Marâtib Qirâ'ah Al-Qur'an. Maratib qira'ah al-Qur'an* consists of six stages, namely *talaffuẓ* (pronunciation), *tafahhum* (understanding), *tadabbur* (contemplation), *tafakkur* (thinking), *takhassyu*'(heartssolemn), and *tanfîẓ* (implementation). These stages can not be separated from one another and these are a one whole unit to be able to study al-Qur'an perfectly.

Based on the description above, then the problem deserves to be studied more deeply by conducting research to formulate integration of *marâtib qirâ'ah al-Qur'an* and Marzano's taxonomy. This integration combines the concept *marâtib qirâ'ah al-Qur'an* with Marzano's taxonomy into one whole unit. From this integration, can be produced a new concept about the classification of learning objectives that is more comprehensive and can be used as a basis formulation of mathematics learning objectives.

II. RESEARCH METHOD

This research is a development research. Development research is a type of research carried out to develop, deepen, or expand knowledge (education) that already exist [7]. In this case, the researchers will develop a new taxonomy in theory by integrating *Marâtib Qirâ'ah Al-Qur'an* and Marzano's Taxonomy as a basis for formulating learning objectives.

Based on the focus of research, the research was carried out through several stages. *First*, translating the book of *marâtib qirâ'ah al-Qur'an* with the help of an expert in Arabic. Then proceed to do literature study about *marâtib qirâ'ah al-Qur'an* and Marzano's taxonomy. At this stage, the researchers also conducted interviews to the expert of Arabic and Qur'an Education regarding *marâtib qirâ'ah al-Qur'an* and its relevance to Marzano's taxonomy.

Second, developing by combining the concept of *marâtib qirâ'ah al-Qur'an* with Marzano's taxonomy based on the data that has been collected. This stage produces an early research product in draft integration result of *marâtib qirâ'ah al-Qur'an* with Marzano's taxonomy. Then, the draft was discussed with expert of Qur'an Education and the lecturer of Mathematics Education in a sustainable manner to obtain a logical result and answerable.

Third, making a conclusion based on the results of discussions with the experts. At this stage, the researchers developed the concept of integration of *marâtib qirâ'ah al-Qur'an* with Marzano's taxonomy overall, including the description of integration result and the indication of learning achievement in all levels of integration result. In addition, it's also provided the examples of its application in formulating mathematics learning objectives.

In this research, data were collected by using refer to note technique and interviews. Refer to note technique is a technique of data collection by using books, literature or library materials, then note or citing expert opinion that is in the book [8]. Then, the collected data was analyzed by inductively, annotated bibliography, and content analysis. This was done to be able to find the key points of each stage in *marâtib qirâ'ah al-Qur'an* and Marzano's taxonomy. The results of this analysis were used to compose the draft of integration result which consists of definition and goals to be achieved at each stage in *marâtib qirâ'ah al-Qur'an*, Marzano's taxonomy, and the results of integration of both.

III. RESULT AND DISCUSSION

Marâtib qirâ'ah al-Qur'an is the stages of studying al-Qur'an carried out by a Muslim in order that al-Qur'an can be studied as a whole. This theory reviews the stages of studying al-Qur'an. In theory, there are six stages in the review of al-Qur'an. The definition of each stages can be seen in Table 1.

TABLE1. THE DEFINITION OF EACH STAGES IN MARÂTIB QIRÂ'AH AL-QUR'AN

Stages	Definition
1. *Talaffuẓ* (Pronunciation)	Reading al-Qur'an in accordance with the correct pronunciation, performed, and pronounced correctly.
2. *Tafahhum* (Understanding)	Understanding the meaning of the verses of al-Qur'an literally and its content.
3. *Tadabbur* (Contemplation)	Thinking by using the entire intellectual and logical questions to reach a new understanding, which is contained in the texts of al-Qur'an in accordance with the rules of the Arabic language, both connecting between sentences in al-Qur'an and letters in al-Qur'an.
4. *Tafakkur* (Thinking)	Thorough exploration process by contrasting from the meaning of *qauliyyah* verses (text of al-Qur'an) towards reading and analyzing of *kauniyyah* verses (universe) to generate some rules or lessons as a solution to a problem.
5. *Takhassyu'* (Solemn Heart)	Solemn mood as an effect received from the process of *talaffuẓ*, *tafahhum*, *tadabbur*, and *tafakkur* the verses of al-Qur'an.
6. *Tanfiẓ* (Implementation)	Conceiving and realizing the teachings of al-Qur'an in the life whole-heartedly in all aspects of life.

Marzano's taxonomy is a taxonomy of learning objectives to systematically define the variety of skills related to thinking and learning. Marzano's taxonomy reviews a process of student learning and thinking. This taxonomy is organized into 6 levels. The definition of each level in Marzano's taxonomy can be seen in Table 2 below.

TABLE 2. THE DEFINITION OF EACH LEVEL IN MARZANO'S TAXONOMY

Levels	Definition
1. Retrieval	A process of recalling already known knowledge, without necessarily understanding what he/she knows about it.
2. Comprehension	A process of organizing or managing existing knowledge, synthesizing representation (the ability of collecting the same components to form a new thought patterns), the steps are still rudimentary in understanding the basic or initial concept.
3. Analysis	A process of reaching and testing the suitability of knowledge of both the similarities and differences, analyzing the relationships upwards and downwards, classifying, analyzing errors, generalizing, specifying or for a logical consequence or the principle that can forma conclusion.
4. Knowledge utilization	A process of utilizing knowledge which could be a reference or solution, decision making, a question of

Levels	Definition
	experiment and can solve an application related to knowledge.
5. Metacognitive system	A process of monitoring and managing the various objectives of already understood knowledge and maintaining the level of achievement of these goals.
6. Self-system	A process of identifying emotional response, examining perception and self-motivation, testing self-benefit, deciding whether to continue daily habits or choose to reflect into a new activity.

Both of those theories above have relevance one another; reviewing someone's stages in learning. Based on that relevance, can be formed an integration that combines the concept of *marâtib qirâ'ah al-Qur'an* with Marzano's taxonomy into wholy unified concept. This integration produces new concept about the classification of learning objectives that more comprehensive, and can be used as a basis formulation of mathematics learning objectives. Briefly, this integration can be seen in Table 3.

TABLE 3. THE INTEGRATION OF MARÂTIB QIRÂ'AH AL-QUR'AN AND MARZANO'S TAXONOMY

Marâtib Qirâ'ah Al-Qur'an	**Marzano's Taxonomy**	**The Result of Integration**	
		Levels	**Definition**
Talaffuẓ	*Retrieval*	1. Retrieving knowledge (Integration of *talaffuẓ* and retrieval)	A process of remembering, recognizing, and executing already known knowledge correctly.
Tafahhum	*Comprehension*	2. Comprehending knowledge (Integration of *tafahhum* and comprehension)	A process of understanding, symbolizing, identifying and categorizing new knowledge as a basic understanding.
Tadabbur	*Analysis*	3. Analyzing knowledge (Integration of *tadabbur* and analysis)	A process of thinking about a meaning of knowledge in depth, which is carried out by comparing, classifying, concluding (specifying or generalizing), and analyzing errors the knowledge to generate new knowledge.
Tafakkur	*Knowledge utilization*	4. Utilizing knowledge (Integration of *tafakkur* and knowledge utilization)	A process of utilizing already known knowledge and juxtaposing with existing natural signs or phenomena as a basis for investigation, experimentation, problem solving, and decision making of a problem related to the knowledge.
Takhassyu'	*Metacognitive system*	5. System of self-control (Integration of *takhassyu'*, metacognitive system, and self-system)	A system involving self or heart to reach a deeper meaning of already owned knowledge, which is carried out by reflecting a thinking process that has been mastered by students and identifying an emotional response, motivation, and self-benefit of a new task faced by students.
	Self-system		

The levels of integration results are described below.

A. *Retrieving knowledge (Integration of talaffuẓ and retrieval)*

The first level, retrieving knowledge, was formed by integrating *talaffuẓ* and retrieval. Both of these (*talaffuẓ* and retrieval) have a slice each other, the *talaffuẓ* process goes on by using students' memories about *hijaiyah* letter (how to read and reading rules) in recognizing the verses of al-Qur'an were pronounced, how they should read these verses with correct recitation rule. This is similar to the processing knowledge goes on at retrieval level. Based on that slice, it is formed a new definition for level 1 of the integration result.

In the definition, it is obvious that the section taken from *talaffuẓ* is "implementing knowledge correctly". Reading, performed and pronounced in *talaffuẓ* are merged into one process, executing. While the section taken from retrieval is "recalling already known knowledge". In the retrieval, it is also followed by a process of recognizing and executing already known knowledge correctly. It is suitable with the description of the goals to be achieved in the retrieval level.

Retrieving knowledge is the lowest thinking process in a learning taken by students. When the students face a task in the learning process, they are only required to be able to remember, recognize, or execute the knowledge possessed to complete the task.

In the process of remembering knowledge, the indications that arise are: students can remember, mention, enunciate, pronounce (a name, word, or term), utter, give examples, list, label, and describe (who, what, where, when) based on the information that has been saved. In the process of recognizing knowledge, the indications of achievement are: students can recognize, select and identify from a list, and determine the truth of a statement. While in the process of implementing knowledge, the indications of achievement are: students can practice, demonstrate, show, equip, and chart based on the knowledge possessed.

Here are examples of mathematics learning objectives and their instrument about fraction at 7th grade that are formulated based on the indications of learning achievement at levels 1.

TABLE 4. THE MATHEMATICS LEARNING OBJECTIVES AND THEIR INSTRUMENT
BASED ON THE INDICATIONSOF LEARNING ACHIEVEMENT AT LEVEL 1

Learning Objectives	Instruments
1. Given a fractional number, students can identify the parts of these fractional number.	1. In fractional number $\frac{2}{5}$, which one as the denominator?
2. Students can calculate a multiplication result of any fractional number with integer.	2. What is the result of$18 \times \frac{1}{9}$?

B. Comprehending knowledge (Integration of tafahhum and comprehension)

Comprehending knowledge was formed by integrating *tafahhum* and comprehension. *Tafahhum* is a process to understand the verses of al-Qur'an literally and their content based on the books of *tafsir al-Qur'an*. This means that it is just as a basic understanding of the verses of al-Qur'an. As well as the comprehension, this process is carried out only to understand the basic or initial concept of knowledge. This is the slice of *tafahhum* with comprehension. Based on the slice, then it is formed a new definition for level 2 of the integration result.

In the definition, it is obvious that the section taken from *tafahum* is "understanding new knowledge as a basic understanding". Understanding the meaning literally in *tafahhum* is an analogy to a basic understanding of knowledge. While the section taken from comprehension is "symbolizing, identifying, and categorizing new knowledge as a basic understanding."

Comprehending knowledge is a level 2 thinking process in a learning taken by students. When the students face a task or a problem in the learning process, they are required to be able to understand the knowledge, symbolize it in the form of graphs, diagrams, symbols, or charts, identify the essential elements of knowledge, and put the essential elements in the appropriate category to solve the problem.

In the process of understanding knowledge, the indications of achievement are: students can describe, explain, and elucidate the meaning of certain facts or concepts in knowledge. In the process of symbolizing knowledge, the indications that arise are: students can symbolize, depict, represent, illustrate, draw, visualize, create a graph, create a chart, and create a model of the knowledge possessed.

The next is a process of identifying knowledge. The indications in this process are: students can describe the core part, describe how or why, and paraphrase (reiterating a fact or concept in another form to explain its meaning) the knowledge possessed. While the indications in the process of categorizing knowledge are: students can make a connections between, describe a relationship between, and summarize the knowledge possessed.

Here are examples of mathematics learning objectives and their instrument that are formulated based on the indication of learning achievement at level 2.

TABLE 5. THE MATHEMATICS LEARNING OBJECTIVES AND THEIR INSTRUMENT
BASED ON THE INDICATIONS OF LEARNING ACHIEVEMENT AT LEVEL 2

Learning Objectives	Instruments
1. Students can explain the meaning of fractional number in their own words.	1. Explain the meaning of fractional number in their own words!
2. Students can illustrate elements of problem in an image.	2. Ahmad follow a bike racing. During the race, the road is very slippery. After cycled as far as$\frac{1}{4}$ of the track, Ahmad fall. Then he goes racing back. But after taking two-thirds of the track, he fall again and can not continue the race because the bike was badly damaged. Describe in an image Ahmad's race track in accordance with the situation?

C. Analyzing knowledge (Integration of tadabbur and analysis)

Analyzing knowledge is the integration result between *tadabbur* and analysis. Both processes have each slice. *Tadabbur* is carried out to uncover the overall verses of al-Qur'an, to understand those verses in depth. As well as analysis, this process is carried out to analyze the knowledge possessed overall. Both processes seek to generate new insights and knowledge based on the knowledge possessed.

In the definition of analyzing knowledge, it is obvious that the section taken from *tadabbur* is "thinking about a meaning of knowledge in depth to generate new knowledge". This thinking process is carried out by analyzing texts, reasoning, generalizing thematically, analogizing, associating, *ta'wil*/interpreting, and concluding. While, the section taken from analysis is not quite different with the various processes in *tadabbur*, that is "a process of comparing, classifying, concluding (specifying or generalizing), and analyzing errors of the knowledge to generate new knowledge".

Analyzing knowledge is the level 3 thinking process in a learning taken by students. In this level, students are required to be able to compare, classify, analyze errors, and conclude knowledge, both specify and generalize, to generate new knowledge.

In the process of comparing knowledge, the indications of achievement are: students can associate, compare, differentiate, contrast, analogize with certain knowledge, sort, and categorize various knowledge that has been owned by the students. In the process of classifying knowledge, the indications achievement are: students can identify different kind of knowledge, classify, organize, arrange the knowledge, and identify the broader category.

The next is the process of concluding knowledge, which consists of generalizing and specifying. In the process of generalizing, the indications of achievement are: students can make a certain rule, generalization, or principle; generalize; and conclude based on some specific information. Whereas, the indications of achievement in the process of specification are: students can interpret or *ta'wil* (interpret the implicit meaning) a problem; develop and sustain the argument; and conclude, predict or decide something that will happen.

The latter process is analyzing errors. The indications of achievement in this process are: students can identify a problem, issue, misunderstanding; analyze and diagnose a fault in a certain topic; judge, criticize, and fix it to get a logical and accurate knowledge.

Here are examples of mathematics learning objectives and their instrument that are formulated based on the indication of learning achievement at level 3.

TABLE 6. THE MATHEMATICS LEARNING OBJECTIVES AND THEIR INSTRUMENT BASED ON THE INDICATIONS OF LEARNING ACHIEVEMENT AT LEVEL 3

Learning Objectives	**Instruments**
1. Students can explain the reason why $\frac{a}{b} \div \frac{c}{d}$ is equal to $\frac{a}{b} \times \frac{d}{c}$, which a, b, c, and d are natural numbers.	1. Explain the reason why the division of $\frac{2}{3} \div \frac{11}{12}$ can be written as $\frac{2}{3} \times \frac{12}{11}$!
2. Given few decimal number, students can identify the numbers that can be converted into fractions.	2. Which of the following numbers that can be converted into fractions? a. 3,141592 ... c. 2,1232323 ... b. 0,717273 ... d. 1,987189 ...

D. *Utilizing knowledge(Integration of tafakkur with knowledge utilization)*

Utilizing knowledge is the integration result between *tafakkur* and knowledge utilization. Both of these have a slice each other, which *tafakkur* process is carried out by starting from the meaning of *qauliyyah* verses (text of al-Qur'an) to the reading and analyzing *kauniyyah* verses (universe) to generate a solution of a problem. As well as knowledge utilization, which is the process of utilizing knowledge that become a reference in solving problems related to knowledge. It shows that in both of these processes, students attempted to use their knowledge to solve a problem related to the knowledge.

In the definition of the level 4 integration results, it is obvious that the section taken from *tafakkur* is "utilizing already known knowledge and juxtaposing with existing natural signs or phenomena". This is carried out to generate a solution of a problem. While the section taken from knowledge utilization is "utilizing already known knowledge as a basis for investigation, experimentation, problem solving, and decision making of a problem related to the knowledge".

Utilizing knowledge is a level 4 thinking process in a learning taken by students. In this level, students are required to conduct an investigation, experimentation, problem solving, and decision making of a problem by utilizing already known knowledge and juxtaposing with existing natural signs or phenomena.

In the process of conducting an investigation, the indications of student achievement are: students can investigate why and how something can happen, examine the characteristics of something that has been defined, and investigate what would happen if certain treatment or condition is given. In the process of conducting an experiment, the indications of achievement are: students can generate and test hypotheses, test produced ideas, predict what will happen, and determine an explanation of certain theory.

Then, in the process of problem solving, the indications of achievement are: students can resolve and overcome problems associated with the knowledge, find a strategy to solve problems, or develop a way to achieve a goal under certain conditions. While in the decision making process, the indications of achievement are: students may take a decision, consider and choose the best way to achieve a goal based on some options.

Here are examples of mathematics learning objectives and their instrument that are formulated based on the indication of learning achievement at level 4.

TABLE 7. THE MATHEMATICS LEARNING OBJECTIVES AND THEIR INSTRUMENT
BASED ON THE INDICATIONS OF LEARNING ACHIEVEMENT AT LEVEL 4

Learning Objectives	**Instruments**
1. Students can solve a problem related to fractions and tenancy law in real life.	1. Harits has made *ijarah* (tenancy) agreement of Avanza car for homecoming with the deal price of Rp 5,850,000 within a month. After, it's used for 10 days, the car was damaged and Harits decided to cancel the agreement. If the general price within 10 days (the period after using a car) worth Rp 2,500,000 and the general price within 20 days (the period before using a car) worth Rp 4,000,000. So,how much cost of the rent should be paid by Harits for 10 days?
2. Students can develop a strategy to solve a problem related to fractions and inheritance law.	2. Once, there was a father who died and left three sons. He wrote a testament that his heritage in the form of goats was divided by division as follows: - The first son got half $\left(\frac{1}{2}\right)$, - The second son got $\left(\frac{1}{3}\right)$, and - The youngest son got $\left(\frac{1}{9}\right)$. Well, then a problem arose because the number of goats are 17 goats. With simple math, the eldest son should gets $8\frac{1}{2}$goats, the second son gets $5\frac{2}{3}$ goats, and the youngest son will gets $1\frac{8}{9}$ goats. However, they wanted the goats alive. If they divide the goats in that way, there would be few goats to be slaughtered. So, how was the way to divide the goats? Can you help them?

E. System of self-control (Integration of takhassyu', metacognitive system, and self-system)

System of self-control was formed by integrating among *takhassyu*', metacognitive system and self-system. These three processes have slice to one another, that is the involvement of heart, self, or affective side of students in carrying out these three processes. *Takhassyu*' is a process of gaining the deeper meaning of knowledge that has been processed in the previous stages by using heart solemn. As well as metacognitive system and self-system. In both of these systems, students have been involved their affective side in undergoing a learning process, so that they are able to reflect the learning process that they have been mastered, recognize and develop themselves [9].

Additionally, Suryanti [10] states that according to al-Ghazali, *khussyu*' includes six things, namely the presence of heart (*hudhurul qalb*), understanding between the read and done (*tafahhum*), glorifying Allah SWT (*ta'ẓim*), feeling daunted towards Allah SWT (*haibah*), feeling full of hope to Allah SWT (*raja'*), and feeling ashamed to Him (*haya'*). One part of *khussyu*', namely "*tafahhum*" which can be interpreted as conscious or understand, has relevance to the meaning of metacognitive. Metacognitive can be defined as the awareness of thinking process. In this case, metacognitive system is responsible to monitor the thinking process of students in order to operate properly.

While another part of *khussyu*', the "*hudhurul qalb*" which means the presence of heart or self, has relevance to the self-system. The relevance is clearly seen in the self-system,that the system also involve the self in the acquisition of knowledge and thinking processes that had been owned by students. "*Raja*'" or feeling full of hope to Allah SWT, may also be related with the self-system. The feeling full of hope related with self-motivation which is organized in the self-system. These further relevances strengthen the integration among *takhassyu*', metacognitive system and the self-system.

Based on these relevances, then formed a new definition of the level 5 integration result, as set out in Table 3. In the definition of level 5, it is obvious that the section from *takhassyu*' is "a system involving self or heart to reach a deeper meaning of already owned knowledge". It is obvious, because *takhassyu*' is a process that is carried out after the process of *talaffuẓ*, *tafahhum*, *tadabbur*, and *tafakkur* verses of al-Qur'an. The section taken from the metacognitive system is "a system involving self, which is reflecting a thinking process that has been mastered by students". It refers to the ability to set objectives to be achieved in a task and maintain the level of achievement in these objectives. The section taken from the self-system is "a system involving self, which is identifying an emotional response, motivation, and self-benefit of a new task faced by students".

The system of self-control occupies in level 5 or the last level in a learning taken by students. This system is not a process that has a direct indication. This system only supports the implementation of thinking process and exist inside the self or heart of person. The sign for the success of this system is the success that was also achieved in the thinking process at other levels.

IV. CONCLUSION

Based on the results of research on integration of *Marâtib Qirâ'ah al-Qur'an* and Marzano's Taxonomy and its application in the mathematics learning, then obtained some conclusions as follows. Integration of *marâtib qirâ'ah al-Qur'an* and Marzano's taxonomy produce 5 new levels in the classification of learning objectives that is more comprehensive. Five level, namely: 1) Retrieving knowledge (Integration of *talaffuẓ* with retrieval); 2) Comprehending knowledge (Integration of *tafahhum* with comprehension); 3) Analyzing knowledge (Integration of *tadabbur* with analysis); 4) Utilizing knowledge (Integration of *tafakkur* with knowledge utilization); and 5) System of self-control (Integration of *takhassyu*', metacognitive system, and self-system).

Indications of learning achievement at any level of the integration results refer to the processes at any level as follows. Retrieving knowledge consists of a process of remembering, recognizing, and executing knowledge. Comprehending knowledge consists of a process of understanding, symbolizing, identifying, and categorizing knowledge. Analyzing knowledge consists of a process of comparing, classifying, analyzing errors, and concluding knowledge, both specifying and generalizing. Utilizing knowledge consists of a process of investigation, experimentation, problem solving, and decision making. System of self-control has no direct indication.

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Probabilistic Thinking of Elementary School Students in Solving Contextual and Non Contextual Probability Tasks

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***Abstract*—**The aim of this research was to describe the probabilistic thinking of elementary school students in solving contextual and non contextual probability tasks. The subject was a student of fifth grade and a communicative boy. The triangulation of data of subject was used in difference time. The data analysis was categorizing, reducing, explaining, interpreting and concluding data. The result showed that in non contextual probability tasks, he could determine all possible outcomes in one-dimensional but failed in two-dimensional sample space. He failed in event and comparison probability tasks. He thought all events had opportunity to occur. However, in contextual probability tasks, he determined all possible outcomes in one- and two-dimensional sample space by using *odometer* strategy. Meanwhile, he used *numerator* strategy in solving probability event task to examine the part that corresponds to the event. In solving comparison probability task, he thought that a situation would give much more opportunity for target event, if it had a little bit sample space than other situation. This result was important for curriculum developer to introduce probability to elementary school students by probability contextual tasks related to their childhood.

Keywords:*Probabilistic Thinking, Elementary School Students, Contextual Probability Task, Non Contextual Probability Task*

I. INTRODUCTION

Advances in science and technology can not be separated from the human mind. A lot of scientists who have done some experiments as result of his thinking in develop science and technology and can be useful for humans in implementing for their survival. It is clear that the scientists just do not do the deterministic thinking in his job, but they also need to do probabilistic thinking. Because probabilistic thinking can provide a rational framework for making inferences and test hypotheses based on uncertainempirical data. For example, a scientist states that the drug has been produced, 99% could increase the child's appetite, after doing some research in the laboratory.

The example above show that the scientists provide conclusions related to events that will occur at the drug was produced by stating that the drug has been produced 99% could increase the child's appetite. 99% shows the degree of confidence of scientists to the drugs that has been produced. This confidence level appears based on the probabilistic thinking. Itmeans that scientist has estimated the success of the drug to the increase child's appetite with a notice things, so that it appears as a measure of the quantity estimation results.

One of the concepts to study the quantity of the magnitude of the degree of confidence is the probability. Further,[1]stated that the probability was the study of likelihood and uncertainty. It played a critical role in all of the professions and in most everyday decisions.[2]stated that the probability was the mathematical way to deal with problems of uncertainty. It was a tool for measuring the appearance chance of events. [3]explainsed that the probability was an old mathematical discipline dealing with calculating the probability of various events.[4]suggested that the probability of any event was expressed as a ratio of the number of potential outcomes that may be Considered successful over the number of all possible outcomes, successful plus unsuccessful. This was in line with the opinion of[5] which stated that the probability was an assigned value (actually an estimate) given to the likelihood of a particular outcome occurring in a random situation. It was calculated by forming a part-whole fraction; the numerator being the number of times an outcome can occur and the denominator being the total number of possible outcomes. While [6]stated that the probabilistic thinking was a mode of reasoning is attempting to quantify uncertainty, as a tool for decision making. In the study [7]the term probabilistic thinking would be used to describe children's thinking in response to any probability situation. Further [8]stated that a probabilistic reasoning implied to reason under uncertainty. This reasoning took in consideration two important components: the variability of the result and randomness. Thus there is a relationship between probabilistic thinking and probability. If probabilistic thinking is the mental activity of a person in response to a situation which contains an element of uncertainty, then the probability is the branch of mathematics that studies the issues that contain elements of uncertainty.

Based on probabilistic thinking and probability explanation, then in an effort to develop probabilistic thinking of students as a preparation to face the science and technology, needs to be done by introducing the material probability to students in primary school. [9]suggested that the probability need to be introduced to students ranging from elementary level, as the foundation of students to study the probability at higher levels.

Lately a lot of researches related to probabilistic thinking of elementary students in response probability tasks. [3]had done research on low-grade students were kindergartens and elementary schools to differentiate among certain, possible and impossible events, and compare the probability of various events. The result of this study was students coulddifferentiate between three events. Further [10]in his study of 404 students in 2^{th} to 6^{th} grade with instruments related to differentiate among certain, possible and impossible events, and compare the probability of various events, determine events most likely to occur, determine the two boxes of the most may produce white or black ball. The results of this study concluded that the majority of students could recognize different events and categorized them based on the probability. Two results of this study stated that elementary students succeed in responding to the standard probability tasks (non-contextual).

In addition, [11] in his study of 29 students aged 14 to 16 years. Types of tasks provided are (1) advertising involving sex of a baby, (2) black and white marble problem, and (3) red and blue marble problem Box A and Box B. Two of the first task were a context task. The analysis was based on four categories of response is non response, non statistical response, partial statistical response and statistical response. The results of this research focused on non statistical response, that wasmany students used strategies based on the experience of culture (beliefs, everyday experience and school) and intuitive strategy. This was in line with the results of the study [12]of the fifth grade elementary school students low math skill in response probability tasks. The subject gave non statistical response that students gave reasons which refered to everyday experience. Student's responded that if Ivan selected the meatball, then he selected tea ice, lemon ice and coconut ice. But when the student answered that Ivan selected a soup, then he selected tea ice and lemon ice while coconutice is impossible. When researcher askedhis reason, the subject replied that the soup did not match with coconut ice. As well as if Ivan selected chicken noodle, then Ivan selectedtea ice and lemon ice. While coconut ice was not suitable for chicken noodle. When the researcher asked why did not match?, subject replied that according to him was not delicious if after eating chicken noodles, drinking coconut ice. This response showed the subjectivity of student is influenced by everyday experience.

Based on the explanations that have been presented, then there are differences of probabilistic thinking of elementary school students in solving contextual and non-contextual probability tasks. This difference becomes the focus of researcher to explore probabilistic thinking of elementary students in solving contextual and non contextual probability tasks. Aspects of probabilistic thinking can be seen from the responses and strategies are used by students in solving probability tasks. [11]developed the four categories of student's responses are non response, non statistical response, partial statistical response and statistical response. The tasks related with list or identify the complete set of possible outcomes in one-dimensional and two-dimensional, [13]in his study stated that there are six strategies could be used by children in completing tasks bear dressed with tops and pants. The strategies were solution strategy A (random selection of items with no rejection of inappropriate items), solution strategy B (trial and error procedure with random item selection and rejection of inappropriate items), solution strategy C (emerging pattern in item selestion, with rejection of inappropriate items), solution strategy D (consistent and complete cyclical pattern in item selection, with rejection of inappropriate items), solution strategy E (emergence of an "odometer" pattern in item selection, with possible item rejection), solution strategy F (complete odometer pattern in the selection of items, with no rejection of items). Furthermore, [14]in his study of 9-year-old students with high ability and low ability, described how the student could construct mathematical ideas for solving problems. When students lack of formal knowledge, they relied on informal model of the problem situation by using a strategy to produce a solution. And there were three strategies used by students in solving a problem, that are non planing, transitional and odometer. And then elaborated again by [15]into 5 strategies were trial and error strategy, emerging strategy, a cyclic pattern strategy, odometer with errors strategy, odometer strategy. The task related with identify and justify which of two or three events are most likely or least likely to occur, [16]stated that there were three strategies used by students in completing the task of this probability, namely (a) a numerator strategy in the which they only examine the part of the set that corresponds to the target of the event, (b) an incomplete denominator strategy in the which they examine the part that corresponds to the complement of the event, and (c) an integrating strategy in the which they relate the number of the target elements with the total number of elements in the set. Further, The task relate with determine and justify: (a) which probability situation is more likely to generate the target event in a random draw, [16]identified three strategies used by students, namely (a) set with more target event, (b) set with less non target event, and (c) set with the greater difference in favor of the target event.

In addition to the response and strategy aspects, there is other aspect that relate to probabilistic thinking is representation. The representation is the result of a person's mental activity that can be seen by naked eye. In connection with the representation of students in solving probability tasks, [7] found that students used the language of an invention or a conventional language to described the part-whole. Meaning of the language of the present invention that one or more students suggested their different ways in describing probability. This language was used either verbally or in writing. As an example of the invention is the use of language "one of three" to described the probability rather than used a conventional language was one-third. And one of the results of research [17]stated that students pay attention of whole with whole description of the spinner with 100% representation. Model area and description of 50% and the phrase "half"were seen familiar to two students at the initial interview.

Based on the explanations that have been presented, the study aims to describe probabilistic thinking of elementary school students in solving contextual and non contextual probability tasks. So the results of this study can provide benefits, especially for curriculum developers to introduce probability to Elementary School by designing an approach or strategy that can accommodate aspects of probabilsitic thinking of students. In addition, the results of this study can complement theories that already exist on probabilistic thinking especially for elementary school students.

II. METHOD

This study will describe probabilistic thinking of elementary school students in solving contextual and non contextual probability tasks. The research reveals a natural phenomenon (naturalistic) of the subject when solving probability tasks and the main instrument is the researcher. Therefore, this type of research is exploratory research, whereas this is a qualitative research approach.

A. *Subject*

Research's subject is a 5th grade student of elementary school with certain criteria, the boy who has high math skill and able to communicate fluently. The reason to choose boy student because according to research [18]boys had scored higher than girls on probabilistic reasoning, while the results of [19]showed that boy have fewer misconceptions than girl. While the selection of students with high math skill because research [20]stated that students with high math skill were able to respond to probability tasks by using a specific strategy and representation.

B. *Instrument*

The main instrument in this study was researcher. And supporting instruments, namely (a) the instrument of mathematical ability of students, (b) instrument probability tasks, and (c) the instrument guided interview. Each contextual and non contextual probability tasks contained about: (1) the sample space was related to identify the complete set of outcomes in a one and two-dimension problem, (2) the probability of an event was related to identify and justify which of event are most likely to occur, and (3) the probability comparison was related to determine and justifywhich probability situation is more likely to generate the target event in a random draw.

C. *Prosedure*

Collecting data in this study was done 2 times, namely the collection of data on probabilistic thinking of elementary school students in solving contextual probability task and non contextual probability task. 1) In non contextual task, the data collection process was begun with the provision of instrument probability task to the research's subject. Subject did probability task according to his ability and write his answer according to what he think. Researcher recorded the subject's behavior (expression), including the unique of the subject when solving probability tasks. Furthermore, researcher interviewed subject related to the aspects about probabilistic thinking. Triangulation of the interview data in this study useddifferent time triangulation, that was comparing and checking data or information from the result of completion probability task without experimentation with different time. 2) After all of the data collection process related to probabilistic thinking of elementary school students in solving non contextual probability task was complete, the process of collecting data to describe probabilistic thinking of elementary school students in solving contextual probability tasks was begun by giving instrument of contextual probability to the research's subject. Researcher recorded the subject's behavior (expression), including the unique things of the subject when solving probability tasks through experiments. Furthermore, researcher interview subject related to aspects the probabilistic thinking. Triangulation of the interview data in this study used triangulation time.

D. Analysis

The process of data analysis in this study consist of:

1. Categorization/Data Classification
   Categorization in this study was defined as the process of selecting and grouping of data that had the same meaning when it was associated with aspects of probabilistic thinking of elementary students.
2. Data Reduction
   Reduction of data in this study was defined as the process of data reduction, that was less unnecessary and irrelevant.
3. Presentation of Data
   Presentation of data in this study was defined as the process of writing the data was already categorized, further examination of the data to determine the consistency of the information was given by subject in order to obtain credible research data (data triangulation).
4. Interpretation of Data
   Interpretation of the data in this study was defined as a process of understanding the meaning of a set of data that had been presented. Furthermore, the discussion and comparing data from credible research with the literature and the particular theory.
5. Conclusion
   Conclusions in this study was defined as the process of formulating the meaning of research of result based on discussions of the data collected. This conclusion meant to described probabilistic thinking of elementary school students in solving contextual and non contextual probability tasks.

III. RESULT

A. Probabilistic Thinking of Elementary School Student in Solving Non Contextual Probability Task

1. Sample Space

A statistical response was given by subject in solving task to identify what color of the ball could be drawn from a box which containing 4 red balls, 3 blue balls and 2 green balls. The subject could determine outcomes in drawn of ball. The strategy was used by the subject showed no trial and error strategy because the subject was not answer the question by trial and error, but the subject gave a reason. The reason of subject is that because ball was randomly drawn from the box. This could be seen in the following interview transcript.

PLTT1N112: What is your answer?
SLTT1N112: It can be red, blue and green
PLTT1N113: The reason?
SLTT1N113: Because in the box, is randomized then taken
PLTT1N114: What does it mean randomized then taken?
SLTT1N114: Because in the box they were randomized and thenit's taken, you can receive red, blue or green colours

Representation was used by the subject in this issue by list all thepossible outcomes.

However, in the sampel space two dimension task he failed to identify a couple of number and color in spinner, when two spinners were playing together. Subject mentioned that the results may be designated by the arrow was the number 1, 2, and blue, yellow, red, green and purple. It could be seen from the transcript of the interview follows.

PLTT1N210: What is your answer?
SLTT1N210: The numbers can be 1 and 2, colors are blue, yellow, red, green, purple
PLTT1N211: The reason?

SLTT1N211: Because when spinner is rotated, it can get number 1 and number 2, and the color blue, yellow, red, green, purple
PLTT1N212: So, it means how many pairs of numberand color that can be designated by the arrow?
SLTT1N212: Seven, here is 5 (pointing spinner color) and 2 ishere (pointing spinner number)
PLTT1N213: What are the seven?
SLTT1N213: Blue, yellow, red, green, purple, 1, and 2

Based on the transcript of the interview above, indicated that the subject did not pair numbers and colors on the spinner.

2. *Probability of an Event*

Subject failed to determine what was most likely of the ball was picked up from a box containing 4 red balls, 3 blue balls and 2 green balls. The subject replied that most probably drawn ball was a ball of red, blue and green. Subject thought that the three colors of the balls had the same chance.

The subject also failed to determine which were most likely to appear,dice more than 3or less than 3 of throwing the dice. Students thought that by throwing dice, a person did not know how many dice that would appear, dice more than 3and less than 3had a same chance to emerge. The transcript of the interview can be seen follow.

PLTT1N315: What is your reason, why are the most likely to appear on the dice that could be more than 3 or less than 3?
SLTT1N315: Because when inflated can be get more than 3 and less than 3
PLTT1N316: How can they are the most likelythe to appear?
SLTT1N316: When inflated can be more than three or less than three
PLTT1N317: What does it mean how can be more than three, less than 3? Why?
SLTT1N317: Yes possibility
PLTT1N318: What is mean of possibility?
SLTT1N318: If inflated upward, typically more than three or less than three
PLTT1N319: Your mean, you do not know will get which?
SLTT1N319: Yes
PLTT1N320: Why did not know?
SLTT1N320: Because when inflated get many numbers

3. *ProbabilityComparison*

The subject also failed to determine where the boxes were most likely to get the black marker, if there were two boxes, the first box contains 3 blue markers and 2 black markers and the second box contains 4 blue markers and 3 black markers. The transcript of the interview can be seen follow.

PLTT1N408: If you want to get a black marker, where the box should you take out?
SLTT1N408: Box I and II
PLTT1N409: Why are I and II boxes?
SLTT1N409: Because box I and II contains a black marker

Based on the transcript of the interview above, indicatesd that the subject could not compare boxes were most likely to produce a black markers in decision markers. Subject thought that the two boxes together contain black marker, so that in taking one of the markers in the box, I and II boxes produce black color markers.

The subject also failed to determine of the spinner which most likely refers to the red color, if there were two different spinners. The transcript of the interview can be seen follow.

PLTT1N505: What spinner should give most likely to the red color?
SLTT1N505: My answer, could spinner A and B
PLTT1N506: How can be spinner A and B?
SLTT1N506: Because when I rotated can get the red color also
PLTT1N508: But if you're asked to choose, what will you choose?The A or B?
SLTT1N508: A and B,Miss
PLTT1N510: The reason?
SLTT1N510: Because when I rotated I can get the red color also
PLTT1N511: How can it get red color, in the A and B?
SLTT1N511: Because when it's rotated it can get the red color also
PLTT1N512: Yeah why you choose both can get the red color?

SLTT1N512: Because in the two spinner, there are red

Based on the transcript of the interview above, indicated that the subject could not compare the spinner which were most likely to produce a red color. In fact, when the researcher asked the subject to choose one spinner, subject still chose A and B. The subject's reason indicated that the subject thought that on both of spinner equally there were red, so that both spinner gave the opportunity to appoint the color red.

B. Probabilistic Thinking of Elementary School Student in Solving Non Contextual Probability Task

1. Sample Space

The statistical respon was given by student to choose one food and one drink that could be ordered by Dinda, since the subject could list all the probably outcomes. The most efficient strategy, namely the strategy odometer was used by subject. This was because the subject chose one food as a constant item which was paired with 3 different drinks to get all couples of food and drink. Representations were written by the subject can be seen in Figure 2.1.

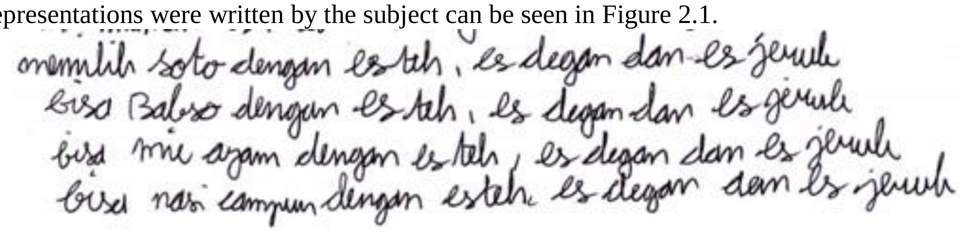

FIGURE 1. Representation of Subjects in Solving 2 Dimensions Sample Space Task

2. Probability of an Event

Partial statistical response was given by subject in solving the probability of an event task. This was because the subject's reason refered to the proportionality misconception, that was the subject chose colors on the spinner which hadnumbers more than others. The transcript of the interview can be seen follow.

PLTT1N706: What color will you choose in order to win this game?
SLTT1N706: I will choose blue, Mam
PLTT1N707: Why do you choose the blue?
SLTT1N707: Because in this spinner mostly blue
PLTT1N708: How many blue?
SLTT1N708: There are 2
PLTT1N709: yellow?
SLTT1N709: 1
PLTT1N710: The Green?
SLTT1N710: 1
PLTT1N711: Do all colors have same size?
SLTT1N711: Same

Based on the interview above, showed that subject used a numerator strategy, because the subject checked the size of each color on the spinner. And colors with the larger size was the color most likely designated by arrows.

3. ProbabilityComparison

Partial statistical response was given by subject in solving comparison statistical of probability task. This was because the subject's reason refered to the proportionality misconception, that was the subject selected a coin because had two sample space, and a dice with many 6 sample space. The transcript of the interview can be seen follow.

PLTT1N808: You're one of the players, do you want to choose to use a coin or use dice?
SLTT1N808: Coin
PLTT1N809: Why do you choose a coin?
SLTT1N809: Because there are 2 pictures
PLTT1N810: What about the dice?
SLTT1N810: There are many pictures, Miss, there are 6
PLTT1N811: But why if the pictures are 2and the other is 6, you will choose the one which has 2 pictures?

SLTT1N811: It can get the number 500 easily
PLTT1N812: What about the dice?
SLTT1N812: To get the number 3 and 5 is difficult
PLTT1N813: Why difficult?
SLTT1N813: Because there are the numbers 1 to 6

IV. DISCUSSION

Overall, students had failed to respond non contextual probability tasks. It appeared that the students failed to respond a couple of numbers and colors when two spinners were rotated, and the students also failed to choose which color ball was most likely to be drawn from the box and which figure was most likely to appear on the tossed of the dice. Students also failed to select box and spinner which were most likely to get a target event. The failure of these students is because students thought that all events had the opportunity to occur.

However, the contextual probability task, student was able to respond to tasks using a variety of strategies and representations. In two-dimensional sample space, student gave statistical response because he could list all possible outcomes with odometer strategy. And students gave partial statistical response on probability of an event. The student's reason refered to proportionality misconception. The numerator strategy was used by students to examine the part of the set that corresponds to the target of the event. In comparison probability task, a partial statistical response was used by student. The student's reason refered to proportionality misconception. Student chose a coin to play. This was because the coin had space samples less than dice, so it more likely had a great chance to win. Itmeans student thought that a situation would give much more opportunity for the target event, if it had a fewer sample space than other situation.

Based on the responses of students in solving contextual and non contextual probability tasks, obviously there are differences. Student is more successful in solving contextual probability tasks. Because, student understand the purpose of the questions easier. In addition, student will think based on his experience in daily life so that student are able to respond and use strategies in solving problems. This is in accordance with the opinion of [14]and [21]which stated that the task of the probability associated with contextual would be easier for students to respond to the task of probabilities, because the task could bring students in everyday life, so that students were able to respond to the task though using their own strategy. However, such a strategy could be redeveloped into a formal mathematical rules. It is important to teach probability for elementary school students, it means the probability can be introduced to elementary school students by probability contextual tasks related to their childhood, such as games etc.

V. CONCLUSION

In non contextual probability tasks, student could determine all possible outcomes in one-dimensional but failed in two-dimensional sample space. Student failed in probability events and comparison probability tasks. Student thought that all events have the opportunity to occur. However, in the contextual probability tasks, student determined all possible outcomes in one- and two-dimensional sample space by using odometer strategy. Meanwhile, student used numerator strategy in solving probability event task to examine the part that corresponds to the event. In solving comparison probability task, student thought that a situation would give much more opportunity for the target event, if it had a little bit sample space than other situation. This result is important for curriculum developers to introduce probability to elementary school students by contextual probability tasks related to their childhood. The result can be used as input for the elementary mathematics curriculum developers to be able to introduce probability in primary level by associating the student's childhood, such as games. Furthermore, the result can be used as input for teachers and other researchers associated with the strategy and approach that must be done to introduce probability for elementary students. In addition, for other researchers need to examine more deeply about probabilistic thinking of elementary school students views of other aspects, so that the study of the probabilistic thinking of elementary school students will be more complete and perfect.

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Students' competence Development on Learning Fractal Geometry by Experiments Using ICT Tool

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Abstract—The new curriculum of high education based on competence of graduates. The competencies that students should develop are comprehending the knowledge and use it to solve the problems by explorative and experiments activities and using appropriate ICT tools. One of the subjects of mathematics that students learn is Fractal Geometry. Geometry is one of the oldest mathematics sciences that never stop to be studied and be developed. The newest geometry that brings us some new perspective is Fractal Geometry. Fractal Geometry based on study about how look like a continuous function that is not differentiable everywhere and this subject brings us to new concepts of dimension that can be a positive rational number. When we study about fractal geometry, one of importances things is how can we develop some fractal objects. One method that can be used to create fractal objects are Lindenmayer system. In order to develop competencies of students, the lecture emphasised the experiments task and used ICT tools to help the students to create some fractal objects. This paper will present how experiment activities using ICT tool helped students to create fractal objects by Lindenmayer system.
Keywords: *sudents'competence, Fractal Geometry, learning by experiments, ICT Tool.*

I. INTRODUCTION

The new curriculum of high education is based on the competence of graduates. The competences that students should develop are comprehending the knowledge and use it to solve the problems by explorative and experiments activities and using appropriate ICT tools. Experiments in mathematics here is an approach using an ICT tool to investigate fractal objects and identify properties and its patterns. With these experiments, the students generate and confirm or confront their conjectures so that they can understand more about the subject they learn than just a theory and can develop some strategies to solve the problems. By using ICT tools, they can discover some new patterns and make a relation and construct some conjectures and testing their conjecture easily. The ICT tools or computer program that are used in this research is open accsess and students are asked to choose the appropriate tool.

The term "fractal" was first used by French-America mathematician, Benoît Mandelbrot in 1975. Mandelbrot based it on the Latin, frāctus meaning "broken" or "fractured", and used it to extend the concept of theoretical fractional dimensions to geometric patterns in nature. A fractal is a mathematical set that has a fractal dimension that usually exceeds its topological dimension and may fall between the integers. Fractals are typically self-similar patterns, where self-similar means they are "the same from near as from far" and exactly the same at every scale.

One method that can be used to create fractal objects is Lindenmayer system or is called by L-systems. Lindenmayer systems were introduced by Aristid Lindenmayer as mathematical formalism for modeling multi cellular organisms that form linear or branching filaments. The basic idea of this system is forming complex objects by successively replacing parts of a simple initial object using a set rewriting rules or productions, usually is done recursively. L-systems are parallel rewriting systems operating on strings of symbols. Lindenmayer system is formed by initial state or axiom, a set of symbols contain production rules. Many fractals can also be thought of as sequences of line segments, depends on the lengths of the line segments and the angles between the line segments.

Example of a Lindenmayer system:
Axiom : -F
Rule : F=F+F-F-F+F (means that we replace F with F+F-F-F+F)
Angle : 90 °
The product of this system are:
n=0, -F
n=1, -F+F-F-F+F
n=2, - F+F-F-F+F + F+F-F-F+F - F+F-F-F+F - F+F-F-F+F + F+F-F-F+F
and so on.

To produce fractal objects, the string generated by Lindenmayer system must contain the necessary information about geometry figure. One interpretation of a string is turtle graphic which translate symbol or string to geometric forms. Geometric Interpretation of the symbols or string are:
F : means move forward one step.
+ : turn left by angle θ
- : turn right by angle θ (is equal 90° if is not determined)
By geometric interpretation above, for n=1 , -F+F-F-F+F we have :

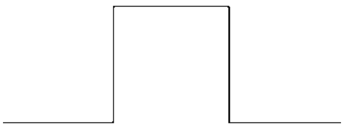

FIGURE 1. FIGURE FOR N=1

And for n=2, - F+F-F-F+F + F+F-F-F+F - F+F-F-F+F - F+F-F-F+F + F+F-F-F+F , here we replace every representation of F by the form of n=1, and the form is below:

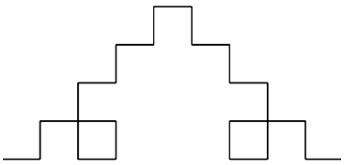

FIGURE 2. FIGURE FOR N=2

If the process continue recursively, for n=5, we have this form:

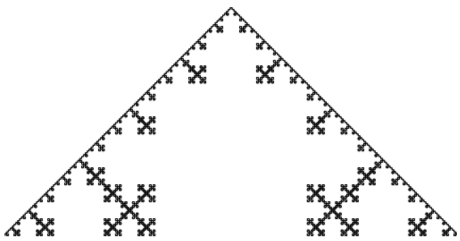

FIGURE 3. FIGURE FOR N=5

II. LEARNING FRACTAL BY EXPERIMENT ACTIVITIES USING ICT TOOL

A. Aim of the research

The aim of this research were to describe how the experiments activities using ICT tool helped the students to develop their competencies to constructs fractal objects and found the relations between the rule of the Lindenmayer system, the angle and its geometric interpretations.

The aims of learning geometry fractal by Lindenmayer systems by experiments are:
(i). The students understand about this system and know how to use this system to create an fractal object.
(ii). The students develop some strategies by experiments when construct a system for some object that are given.
(iii). The students realize the relations between length of line segment, the angle and the object.

B. Subject and method

The subjects of this research were Universitas Negeri Surabaya undergraduate students of fractal geometry class, consisting of 20 students.
To know about the role of the experiments activities using ICT tool in Fractal learning, at first the students were asked to do the tasks without experiments using ICT tools, after several time they worked for the same tasks with experiments using ICT tool that they chose.
The works with and without experiments activities were analyzed and compared.

C. The tasks

The tasks are given to students to construct fractal object by Lindenmayer system were four tasks.
TASK 1
Give the geometric interpretation for n=1 to n=3 of the following Lindenmayer system.
Axiom : F
Rule : F=F+F- - F+F
Angle : 60°.

TASK 2
Given the following image of a phytagorean tree and find the Lindenmayer system for this image.

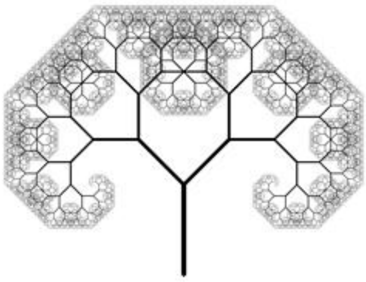

FIGURE 4. FIGURE OF PHYTAGOREAN TREE

TASK 3
Contruct a Lindenmayer system of marigolds leaves (in bahasa: daun kenikir) in which the image is given the following. Describe your strategies to form letter “S” for the stem leaf.

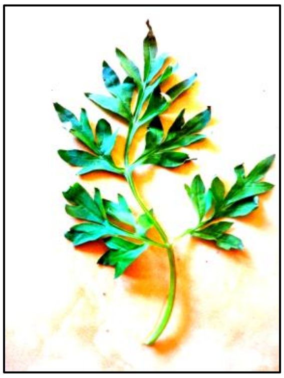

FIGURE 5. FIGURE OF MARIGOLDS LEAVES

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TASK 4
Find an object in your neighborhood, take a photo of this object and construct the Lindenmayer system of this object and give the geometry interpretations of your system.

D. Results

In this section, we describe the works of students with and without experiments using ICT tool.
TASK 1.
There was no different results before and after experiments activities. Almost all students gave the same image, before the experiments they did the interpretation of the given system using ruler and protractor to measure the angle, and after experiments using ICT tool they found the similar shape, looked like the following image:

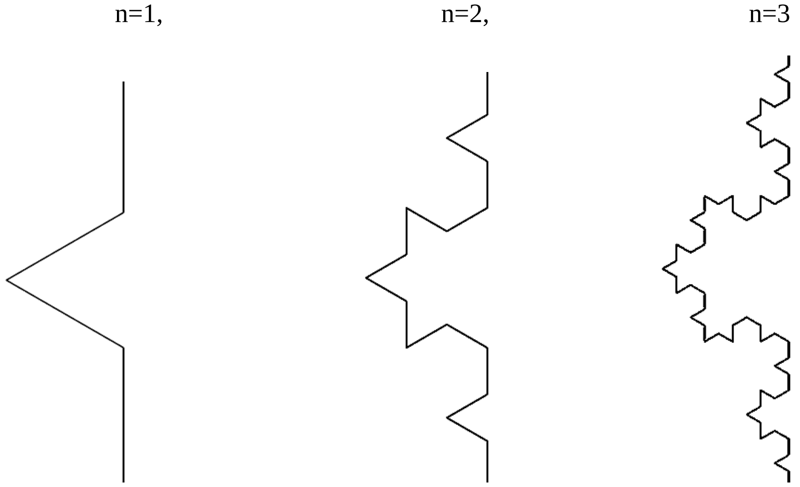

FIGURE 6. GEOMETRIC INTERPRETATION OF THE SYSTEM

TASK 2
Using ruler and protractor, the students measured the lenght and the angle between line segment and the create the system of this Phytagorean tree. The strategies that they used are focus on the stem of the tree and characterized the repeated pattern.
The system that they found without experment did not respect to accuracy of line segment ratio. Here, the Lindenmayer system and geometric interpretation of almost all students,
Axiom : XF
Rule : F=F[+F][-F]
Angle : 45°.
The geometric interpresentation for n=1, 2, 3 and 5.

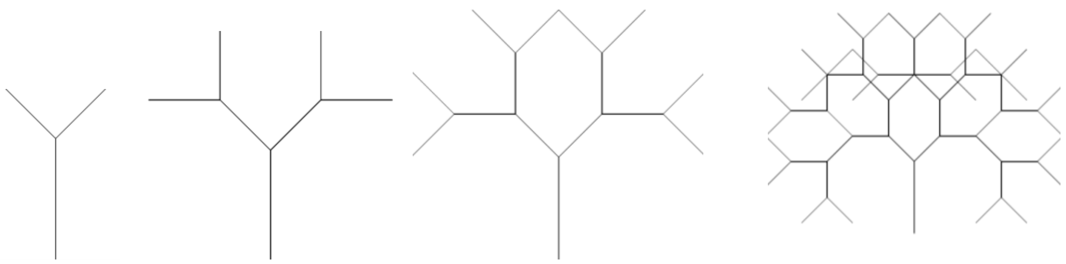

FIGURE 7. PHYTAGOREAN TREE WITHOUT EXPERIMENT

When they used ICT tool to experiment with, they could change the system and saw the changement they made about the ratio of the line segment and rechanged again and again to get the better geometric image.

TASK 3

Before experiments activities, 75% of students said that it is impossible to construct Lindenmayer system for the stem leave with the form "S" shape using line and the angle., and the rest of them said they did not know how to make a "S" shape. The system were created did not product "S" shape for the stem leaves.

The Lindenmayer system :
Axiom : X
Rules : X=F[+X][-X]FX;
F=FF
Sudut : 27^o and the following interpretation for n=1 to 3 respectively.

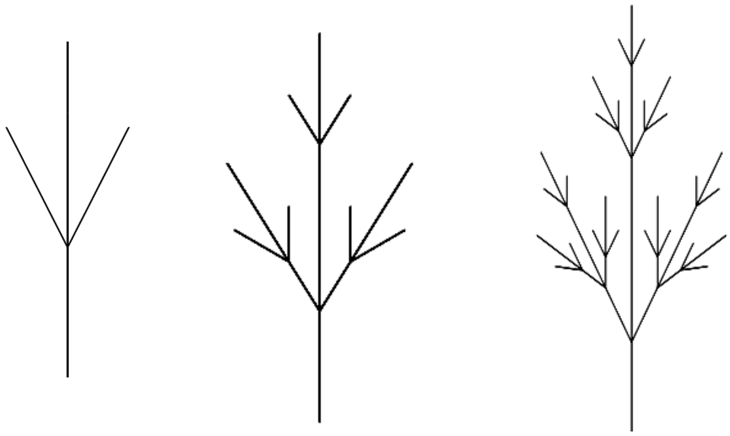

FIGURE 8. GEOMETRIC INTERPRETATION WITHOUT EXPERIMENT

After experiments activities using ICT Tool,
More than 75% of students realized that is possible create "S" form by using line and the angle and after some trial and error they could construct Lindenmayer system for the leave of marigolds. They used the strategies by change the angle small enough to have smooth curve for the stem leaf.
Here the several results of this task, the system and the geometric representations.

(a). Aksioma:
F-F-F-F-F-F-F-F-F-F-[---FFFFFA][F+F+F+F+F+F+F+F+FF-F-F-FA][++++++++++FFFFFA]
Rules: F=FF
A=[-----FFFFFFA][FFFFFFFFFFA][+++++FFFFFFA]
Angle = 7^0
The strategies they used: form a shape of "S" using small angle in axiom for the stem leaf and created the rules for the leaves.
The interpretation using "Inkscape" the produced this image:

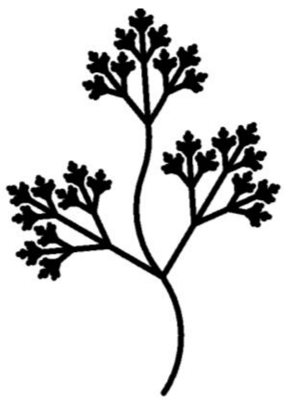

FIGURE 9. INTERPRETATION USING INKSCAPE

(b). Axiom :
F-F-F-F-F-F-F-F-F-F[F-F-F-F--F--A][F+F+F+F+F+F+F+F+FF--F--F-FA][++++F++F++F++F++FA]
Angle : 7°

Initial Angle : 31°
Rules : A=[-----FFFFFFA][FFFFFFFFFFFFA][+++++FFFFFFA]
F=FF
By using fractal grower, they produced this following image;

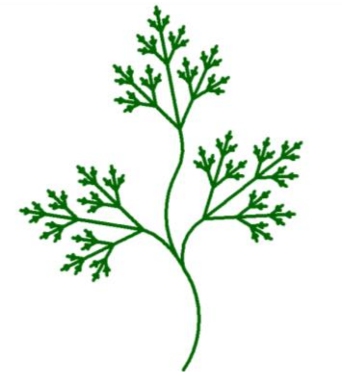

FIGURE 10. INTERPRETATION USING FRACTAL GROWER

TASK 4.
After the students made the constuction for “S” shape, they could create different shape more fluently than before, it is shown from their constructions for this task, when they chose the object freely that they could find in their neighbourhood and the ICT that they used.
Here, some of the works of students,
(a). “Samber gledhek” flower is created using “ Fractal Grower”.

FIGURE 11. SAMBER GLEDHEK FLOWER

Aksioma : ![G][+++F][---F]
Aturan : F=![G][++F][--F]
G=HG
Sudut : 13°

These are the fractal grower production for this system with n=1, 2 and 8 recursively

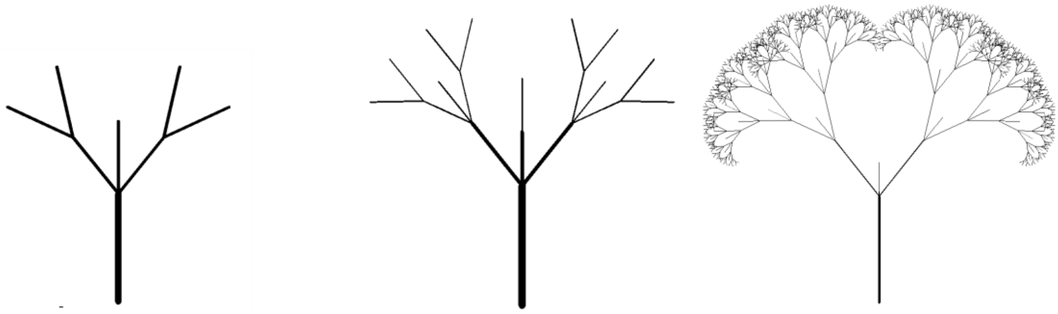

FIGURE 12. GEOMETRY OF SAMBER GLEDHEK FLOWER

(b). Palm tree created by fractal grower

FIGURE 13. PALM TREE

Axiom : !!!![-FFFA]FF[++FFFC]FF[--FFFB][+FFFA][--FFFA][+++FFFD]FFFD
Rules : A=AA[+FFFFF+FFF+F]F[-FFFFF-FFF-F]FA
B=B[+FFFFF+FFF+F]-FC[-FFFFF-FFF-F]FB
C=C[+FFFFF+FFF+F]+F[-FFFFF-FFF-F]FC
D=A[+FFFFF+FFF+F]-F[-FFFFF-FFF-F]FC--A
Angle : 20
The interpretaion of the system using fractal grower for n=1,2 and 4 recursively

FIGURE 14. GEOMETRY OF PALM TREE

(c). Radial tire of a car

FIGURE 15. FIGURE OF RADIAL TIRE

The Lindenmayer system of this tire is:
Axiom : +F+F+F+F+F+F+F+F+F+F+F+F+F
Rules : F=A[+A][- - - - -A][A++AA- -A++F]
Angle : 30
The interpretaion of the system using inkscape for n=1,2 and 4 recursively.

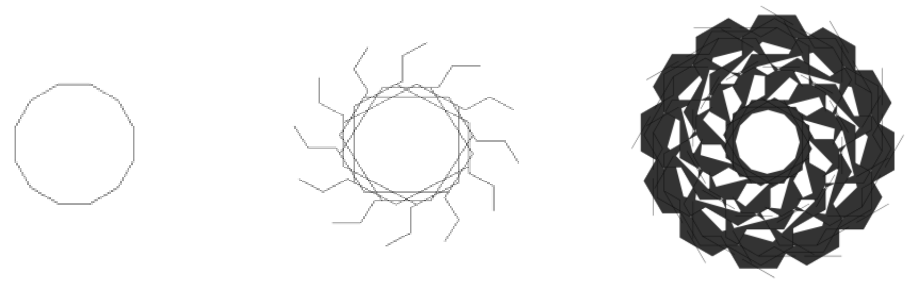

FIGURE 16. GEOMETRIC OF TIRE

III. CONCLUSIONS

From the analized data of the works of students before and after experiments activities, we have:

1. Using the experiments activities with ICT tool, the students realized that a shape “S” can be created using lines with the angle small enough so that the curve is smooth. In other words, the students made a relation between the shape and the angle.
2. The use of ICT tool and experiment activities, helped the students to make a guess about their system for an image and check it and change the system to make a better geometric representation of the system.
3. With using ICT tool, the student could create systems for variuos fractal objects that was difficult to realize without ICT tool.

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ME – 50

Creative Problem Solving to Improve Students' Higher Order Thinking Skills in Mathematics Instructions

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Abstract—The 21st century skills requires students not only have the conceptual knowledge, but also must have the skills to think and skill in the application of knowledge. High order thinking skills (HOTS) is one of the skills that students required to face the competition in the 21st century. One effort that can be done to improve students' HOTS namely through the implementation of creative problem solving (CPS) models in mathematics instruction. CPS can be implemented in mathematics instructions through the steps: (1) finding the objective of the problems (objective-finding); (2) analyzing facts or informations from the problems (fact-finding); (3) analyzing the important questions from the problem (problem-finding); (4) exploring ideas to solve the problem (idea-finding); (5) analyze the advantages and disadvantages of the ideas found (solution-finding); and (6) making the conclusion from the process of problem solving (acceptance-finding). CPS can improve students' HOTS because: (a) the product or outcomes of learning by using CPS can be used to evaluate high order thinking skills; (b) present a meaningful learning activities; (c) effectively used individually or groups; (d) empower students to construct the knowledge; (e) as a variation in learning activities that involve problem solving; (f) fostering the understanding that not all the problems have only one solution that is right; and (g) presentation of challenging problems (creative problem) can attract and motivate students to learn.

Keywords: *creative problem solving, higher order thinking skills, mathematics instructions*

I. INTRODUCTION

In this modern era everyone is required to have a variety of skills. Skills expected as mentioned in "21st century skills" covers creativity, reasoning, and problem solving. These skills can be seen as a higher order thinking skills (HOTS). In order to achieve these objectives various attempts have been made, one of which is through curriculum renewal. In Indonesia, curriculum which leads to increased student HOTS stated in "Curriculum 2013".

Implementation curriculum 2013 in Indonesia is not without obstacles. Retnawati [1] state that junior high school math teachers in Indonesia are still experiencing difficulties in implementing the curriculum in the classroom. The scientific method is becoming a pillar of the curriculum 2013 also can not be implemented effectively. This condition causes students' HOTS in Indonesia is still low.

Still lack students' HOTS in Indonesia apart caused by unreadiness of teachers, it can also be caused by use of the learning model that is less varied. Many literature states that HOTS can be enhanced through learning model that involves students in problem solving activities. It means, HOTS not only can be improved through the scientific method, but also need to try various learning models that oriented on improving students' HOTS.

One of learning models that can be used to improve students' HOTS is Creative Problem Solving (CPS). This article will explore what the CPS and implemented in mathematics instructions, as well as its implications for the improvement students' HOTS.

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II. DISCUSSION

A. Higher Order Thinking Skills

Many experts define HOTS with different approaches and viewpoints. Resnick [2] argues that HOTS is hard to define, but easily recognizable by its characteristics. Further, Resnick [2] reveals some of the characteristics of HOTS, namely: (a) non-algorithmic, meaning that the action steps can not be fully determined at the beginning; (b) complex, meaning that steps can not be seen/predictable directly from a certain perspective; (c) generating a lot of solutions; (d) involve differences of opinion and interpretation; (e) involves the application of multiple criteria; (f) involves uncertainty; (g) requires self-regulated in the process of thinking; (h) involves the meaning impressive; and (i) requires effortfull.

Some of expert opinions relevant to definition HOTS as proposed by Thomas & Thorne [3] which states that the higher order thinking skills is thinking at level higher than just remembering facts or retell something audible to others. Furthermore Thomas & Thorne [3] states that the higher order thinking skills requires one to do something towards the facts, that is understand it, conclude, connect it with others facts and concepts, categorize, manipulate, putting the facts together in new ways, and apply them in finding a new solution of the problem. Lewis & Smith [4] states that higher order thinking skills occurs when a person obtains new information and stored it in memory and associates and or rearrange and extend information to achieve the goal or find a possible answer from confusion conditions. From opinions of experts it can be concluded that the HOTS require existence thinking process that more complex to face a situation or solve a problem.

If it is associated with thinking skills, HOTS can be seen as critical thinking and creative thinking [5, 6, 7,8], problem solving [6, 9], logical thinking, reflective thinking, and metacognitive [8], and decision-making [6]. Whereas if it is associated with cognitive processes in Bloom's taxonomy, the term HOTS often contrasted with the term LOTS (Lower Order Thinking Skills). Cognitive process analysis, synthesis, and evaluation are categorized as HOTS, while knowledge, understanding, and application are categorized as LOTS [10, 11]. Still relevant categorization HOTS and LOTS in Bloom's taxonomy, different opinions expressed by Thompson [12] which categorizes the analysis, synthesis, and evaluation as HOTS, knowledge and understanding as LOTS, while applications in the category HOTS or LOTS.

As if it is associated with Bloom's taxonomy revision proposed by Anderson & Krathwohl [13], the dimension of cognitive processes HOTS includes the process of analyze, evaluate, and create, while the dimensions of knowledge HOTS include conceptual knowledge, procedural knowledge, and metacognitive knowledge. (see. Table 1)

TABLE 1. HOTS IN BLOOM'S TAXONOMI REVISION

		The Cognitive Process Dimension					
		Remember	Understand	Apply	Analyze	Evaluate	Create
The Knowledge Dimension	Factual						
	Conceptual					Higher Order	
	Procedural					Thinking	
	Metacognitive					Skills	

Based on the theories that has been presented, the indicator HOTS in general can be developed through aspects of critical thinking and creative thinking, where these aspects are a major component in the process of higher order thinking skills, according the definition of HOTS noted previously.

Operationally, higher order thinking skills be detailed into indicators based on aspects of critical thinking and creative thinking. According to Ennis [14] critical thinking is "reasonable, reflective thinking that is focused on Deciding what to believe or do". Eggen & Kauchak [15] which states that critical thinking is the ability and the tendency of a person to make and do assessment toward conclusions based on evidence. Based on those two opinions, the critical thinking can be interpreted as an attempt to process and evaluate the information on a situation or issue based on strong evidence and logical. Critical thinking is characterized by ability to analyze and evaluate. The ability to analyze emphasis on the ability to specify a substance into its component parts and seeing the relationships between the parts. Anderson & Krathwhol [13] argues that the ability to analyze operationally characterized by their ability to differentiating, organizing, and attributing. Still according to Anderson and Krathwohl [13], to evaluate the ability can be defined as the ability to make an assessment (judgment) based on the criteria and certain standards. It is characterized by the ability of checking and critiquing.

In a lot of levels of thinking that has been compiled by experts, many of which put creative thinking as the highest levels of thinking. Krulik & Rudnick [7] states that "creative thinking is thinking that is original and reflective and that produces a complex product. ...includes synthesizing ideas, generating new ideas, and determining reviews their effectiveness. ... the ability to make-decisions ... ". Pressesisen [6] argues that creative thinking is using the basic thinking processes to develop or find a new idea or product, aesthetic, and constructive. Creative thinking is emphasized on how to use the information or materials that are known to generate original ideas and elaborating perspective. Based on those opinions, creative thinking is emphasized on how to process the existing information to generate new ideas or products. In other words, the ability to think creatively characterized by ability to create. More specifically Anderson & Krathwohl [13] argues that the ability to create can be characterized by ability to formulate/make hypotheses (generating), planning, and producing.

Based on the description that has been presented about the indicators of higher order thinking skills, the indicators that will be used to measure students' higher order thinking skills are summarized in table 2 below.

TABLE 2. DEVELOPMENT OF HOTS INDICATORS

HOTS Aspect	Indicator	Sub Indicator
Critical Thinking	Analyze	Differentiating
		Organizing
		Attributing
	Evaluate	Checking
		Critiquing
Creative Thinking	Create	Generating
		Planning
		Producing

B. Creative Problem Solving

Creative problem solving (CPS) is seen as one of the forms of variation in problem-based learning. One important and his experience.

Giangreco, Cloninger, Dennis, and Edelman [16] argues that the implications of the use of creative problem aspect that will be developed through this model is creativity of students in mathematics instructions. Bohan & Bohan [17] suggests that if we want students to be creative, we have to offer them something to be creative through knowledge. Thus through the application of creative problem solving, the students have the opportunity to be involved in the creative process in order to build knowledge based on prior knowledge solving in learning for students include:

1. Engage students in solving various problems and challenges in real life which a key characteristic of effective education.
2. Encourage students to believe that they can solve the problem, either independently or with the support of others in the class.
3. Offer opportunities for students (with either high or low academic ability) to assist in solving the challenges faced by them or their classmates and assign all students as a valuable contributor.
4. Offer opportunities for students to engage in the overall class according to their educational needs of each.
5. Offer the opportunity for students to learn and practice problem solving skills in a sustainable to address the relevant challenges.

6. Aspects of collaborative, non-judgmental, and action-oriented of creative problem solving encourage a sense of togetherness in addressing the challenges of concern to groups of students.
7. Encourage and strengthen many academic and affective skills (eg, observation, analysis, evaluation, took a point of view, build other ideas, synthesize ideas).

As for the implications of creative problem solving for teachers in learning [16], namely:

1. Encourage teachers to be open to the possibility that there is more than one correct answer.
2. Encourage teachers to continue to be learners and especially open themselves to learning from the students in their classes.
3. Provides a method to reduce the pressure in learning through group activities in problem solving.
4. Increase the capacity of teachers in teaching all students by identify the options that exist for teaching heterogeneous groups, adapting other options that already exist, and creating new options.
5. Encourage teachers to design attractive learning approaches and actively taking into account the contribution of the students.

Thus the creative problem solving in the learning process can trigger the implementation of active learning. Active here is not only focused that learning is solely centered on the student (student center), but teachers are also required to play a role in creating interesting circumstances of learning and in accordance with the needs of students, and to be able to develop creativity of students.

Associated with the implementation of creative problem solving in mathematics instructions, Bohan & Bohan [17] argues that this model has several characteristics, include: (1) help promote the kind of math class discussion becomes interesting and students excited to work; (2) presenting meaningful activities for students; (3) effectively used individually, cooperative groups, or as a classroom discussion; (4) empowers students to build knowledge in the field of mathematics; (5) produce products that can be used to evaluate higher order thinking skills.

Implementation of creative problem solving in mathematics instructions should be preceded by the presentation of open problems (open-ended) and non-routine [17]. More specifically Loewen [18] states that creative problem solving must use "creative problem". Creative problems is a problem that can be solved using many different strategies and the final answer is not singular [18]. According to Loewen term "creative problem" has differences with term "problems" in general (traditional problem). The difference can be observed through the following scheme:

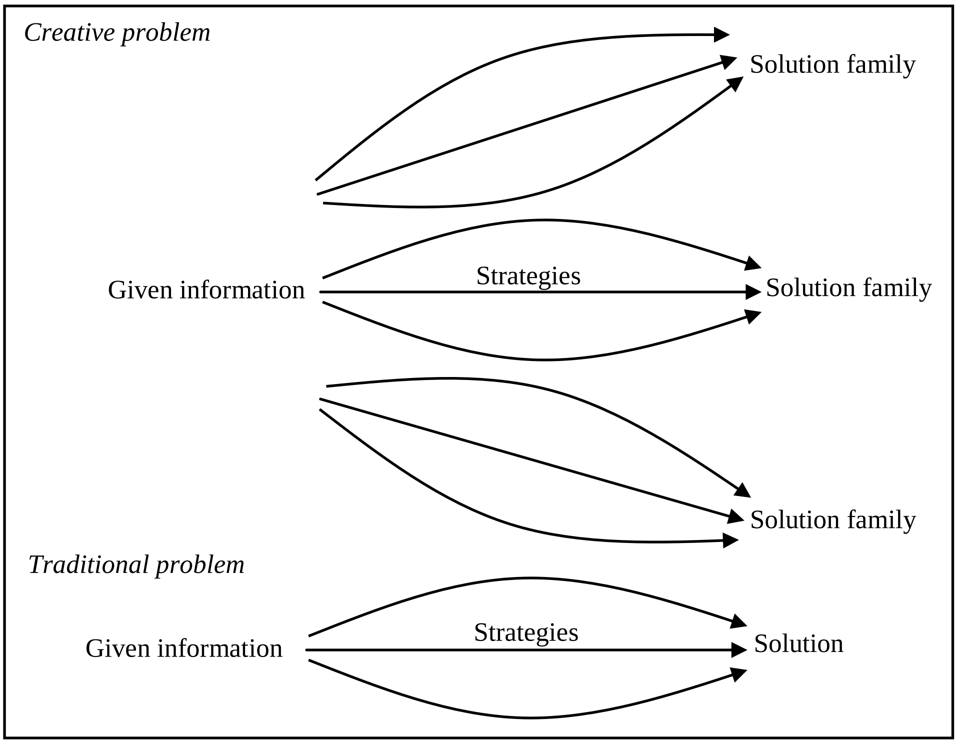

FIGURE 1. SCHEME OF CREATIVE AND TRADITIONAL PROBLEM

From the scheme shows that the traditional problems can be solved using different strategies, but the final answer is singular, whereas creative problem can also be solved using many strategies but produced no single solution.

According to Loewen [18], the advantages of the use of creative problems than traditional problem, namely:

1. Creative problem develop an understanding that not all the problems have only one correct solution.
2. Creative problem is more exciting, so it can add interest. With increasing interest in this, then it can increase the motivation in learning mathematics.
3. Creative problem can stimulate students to continue to consider ways to solve the problem.
4. Creative problem can come up with creative ideas for a problem solver, where this is one of the objectives to be achieved in the learning of mathematics.

In reality, not all mathematics problems can be presented through creative problem that has many solutions. In this case the creative problem solving can be facilitated with the filing of the problems that can be solved through a lot of ways (multiple ways). Pepkin [19] states that although creative problem solving is usually related to a problem that has many solutions, such as those found in management, math usually involve only one solution, but geometry and other material of math often pose a problem where there are a lot of ways to get the same solution. It can be concluded that one of the characteristics of the problems that could be used in the implementation of creative problem solving is a problem that can be solved in many ways (open process).

Based on the description above, it can be concluded that the creative problem solving can be implemented through the filing of a problem as the starting point of learning. the problems that may be filed in the creative problem solving that is open ended problems or creative problem, namely the problem that has many ways of settlement and many of the solutions, and the problems an open process, which is a problem that has many ways of settlement and a single solution.

Giangreco, et al [16] states syntax of creative problem solving that was adopted from Osborn (1993) and Parnes (1992) include:

1. Visionizing or Objective-Finding, which at this early stage, problem solver increase their awareness through imagining (imagined) potential challenges given.
2. Fact-Finding, where problem solver collect much information as possible about the challenges that selected by using all their senses and perceptions. By asking "who, what, where, when, why, and how". Problem solver completed this phase by identifying the facts that they believe are most relevant to the challenges.
3. Problem-Finding, where the purpose of this phase is to clarify the challenges or problems by redefining with new and different ways. By repeating the challenge as a question, "In what ways might I/we...?"; and by asking the question "Why?" or "What would really me/us to accomplish?" This process is repeated until a problem solver restate the problem in a way that the most reasonable and the most attractive for them.
4. Idea-Finding, this phase aim to generate as many ideas as possible that could potentially be used to solve the challenges or problems. At this phase problem solver try to make new connections between ideas by analogy, the manipulation of ideas, or create a new association from another ideas.
5. Solution-Finding, which at this phase problem solver will consider various criteria and was chosen to evaluate the advantages of the ideas put forward. Problem solver using criteria to assist in selecting the best solution.
6. Acceptance-Finding, where problem solver fix or repaire solution to be more easily applied. The goal is to transform ideas into action through the development and implementation of action plans.

C. Why CPS can improve students' HOTS?

Models of teaching can be used to improve students' higher order thinking skills is a model of teaching in which involves a problem solving activity. One model of teaching that involves problem solving activity that is creative problem solving. Noller [20] states that creative problem solving can be defined as a process, method, or system to approach a problem in an imaginative way and produce effective action. The same thing was stated by Treffinger [21] that creative problem solving is a framework in which individuals or groups can use it to: formulate the problem, have the opportunity or challenge; generate and analyze a lot of new ideas; and planning and implementing new solutions or action programs effectively. From both these opinions seem that creative problem solving is one alternative that can be used to solve the problem through a process of creative thinking.

CPS can be used to improve students' higher order thinking skills, as the opinion argued by Bohan & Bohan [17] that the product or the learning outcomes using CPS can be used to evaluate high-level thinking skills. There are several other reasons that CPS models used effectively to improve student HOTS:

1. In objectives finding phase, students are invited to analyze the objectives of the problem or challenge, it certainly can train students to think critically, where students are required not only understand the problem, but also need to know "for what" the problem is resolved.
2. In fact finding phase, students are asked to identify all the important informations contained on the problem. It can be used as a tool to train students to think critically, and can also be used as a reference that students begin to understand the problem.
3. In problem finding phase, students are asked to formulate the important questions of the problem or question relevant with the purpose of problem submission. In this case the students return required to be able to identify points that can be used as a guideline in preparing the questions, or at least the students were able to reformulate these questions in their own language. Similarly, the fact finding phase, this phase can also be used as a tool to improve students' critical thinking skills.
4. In idea finding phase, students are asked to explore ideas that can be used to solve the problem. The ideas came up expected purely arrival from result of students thinking. In this phase students can exchange opinions with friends to explore the possibility of ideas that can be used to solve the problem. Moreover, at this phase, students can also utilize a variety of learning resources that are relevant in order to find creative ideas. This process is expected to help students develop their creative thinking skills in solve the problems. This is based on presence student’s activity to create or formulate ideas that can be used to solve the problem.
5. In solutions finding, students are asked to apply the ideas that successfully formulated in ideas finding phase. In this phase, the students are expected to choose the best idea from the ideas that they found earlier. This requires students to be able to analyze the advantages and disadvantages of each idea that has been presented in the previous phase. Furthermore, students are expected to take a decision to determine which ideas will be used to solve the problem. These activities can certainly be used as a tool for students to train higher order thinking skills.
6. In acceptance finding phase, students are required to be able to make a conclusion of the process of solving the problem that they do. The formulation of this conclusion should be aligned with the formulation of the questions in problem finding phase. Thus, students are expected to make the appropriate conclusions.

Some other advantages of the implementation CPS in mathematics instructions in context of enhancement students’ HOTS:

1. Presenting meaningful learning activities, where meaningful learning can help students develop their creativity, so as to improve students’ HOTS.
2. Effectively used individually or in groups. Learning in group is needed students to exchange ideas and concepts. Such a process is needed to help improve students’ HOTS.
3. Empowering students to construct the knowledge. One of the factors that may affect the increase of students’ HOTS are familiarized students to construct the knowledge, not received the knowledge from teachers.

4. As variations in learning activities that involve problem solving. Problem solving as one of the strategies to improve students' HOTS, but it is very important to give the variation in problem solving activities, so that the students do not get bored.
5. Cultivate the understanding that not all the problems have only one correct solution. The presence of understanding of the students that there are mathematical problems that have more than one correct solution can train students to try various alternatives in finding solutions of the problems. This will further raise critical power and creativity of students.
6. Presentation of the challenging problem (creative problem) can attract and motivate students to learn. Challenging problems is the key factor in sharpening students' HOTS, which means that teachers have a role to facilitate students through submission the creative problems.

III. CONCLUSION

Models of teaching can be used to improve students' HOTS is a model of teaching in which involves a problem solving activity. One model of teaching that involves problem solving activity that is creative problem solving (CPS). CPS can be implemented in mathematics instruction through the steps: (1) finding the objective of the problems (objective-finding); (2) analyzing facts or informations that is critical of the problems (fact-finding); (3) analyzing the important questions of the problem (problem-finding); (4) exploring ideas to solve the problem (idea-finding); (5) analyze the advantages and disadvantages of the ideas found (solution-finding); and (6) implementing the best ideas to solve the problem (acceptance-finding). CPS can improve student's HOTS because: (a) the product/outcomes of learning by using CPS can be used to evaluate high order thinking skills; (b) present a meaningful learning activities; (c) effectively used individually or in groups; (d) empower students to construct the knowledge; (e) as a variation in learning activities that involve problem solving; (f) fostering the understanding that not all the problems have only one solution that is right; and (g) presentation of challenging problems (creative problem) can attract and motivate students to learn.

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ME – 51

Effect Size Of Pakem Model Implementation In Mathematic Learning On Improving Student's Problem-Solving Mastery On Function Material At Junior High School

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Abstract

This research is motivated by the level of junior high school students' mathematical problem solving was still low. Based on the preliminary study which conducted by one of the schools in Batam shows the average score for mathematics was 62 for 100 scale. The purpose of this study is to obtain and investigate the improvement of students' problem-solving mastery on relations and functions material as the effect of PAKEM model. The research method which used is pre-experiment and with one group pretest-posttest design. The subjects of this study were VIII grade students of one of the first junior school in Batam at odd semester 2015-2016 academic year, totally 32 students. Sample of this research were taken by random sampling technique. Students' problem solving mastery was measured by using problem-solving test, whereas the students' problem-solving mastery improvement between before and after the concept of effect size implementation was calculated to find the effect size of applying the PAKEM model. The result showed that the effect size of applying the PAKEM model on improving problem solving mastery is 3.3, it means, the PAKEM model implementation on improving problem-solving mastery on function has a strong influence. It can be concluded that the PAKEM model implementation can improve problem solving mastery.

Keywords: *effect size, the PAKEM model. problem-solving mastery*

I. INTRODUCTION

One of the goals of maths learning at school is to develop students' maths problem solving mastery. According to Devlin (Kurniawan, 2010), he explains that maths problem solving mastery is an important element in every learning process at any education levels and as one of the strength as the aim of maths learning at every junior high school level which gives a big change to the students to solve every problem related to the daily life,job, and other science matters.

The effort to develop maths problem solving mastery needs educators and researchers' attention seriously, because facts in the field, explains that maths problem solving mastery needs a serious attention and indicated as students' weakness point. The result of international survey report related to students' maths problem solving mastery in Indonesia,namely; Trends International Mathematics and Study (TIMSS) and the Programme for International Student Assessment (PISA) (Wardhani and Rumiati , 2011) points that Indonesian junior high school students' maths problem solving mastery in unroutine matters (mathematical problems) are still weak.

Learning process Improvements, especially in using appropriate models in learning process is one of solutions which researchers consider can improve students' maths problem solving mastery. One of suitable models to solve this problem is PAKEM. Model. PAKEM. Model will help students to maximize problem solving mastery, and be able to be to compete, active, effective, creative and intelligent in improving problem-solving mastery whithin himself. According to Daryanto (2013: 117), PAKEM Model is a learning model that allows students perform variuous activies (learning process)to develop the skills, attitudes, and understanding about various learning sources and devices including environment utilization so that learning more interesting, joyful, and effective. Besides it, PAKEM Model will invite students be able to maximize problem-solving mastery and to compete, role actively, effectively, creatively and intelligently on improving problem-solving mastery whithin himself.

The purpose of this study is to know the effect size of the implementation of PAKEM model in improving students' maths problem solving mastery in the functions material.

II. THEORIES

Rusman (2010 : 322) , PAKEM model is a learning model and becomes as a guideline in reaching assigned goals.PAKEM model characteristics:

1. Active

   It means, this learning model allows learners to interact actively with the environment , manipulate objects in it and observe the effect of those object manipulations.
2. Creative

   It means , learning to build learners' creativities in interacting with their environment, materials and other learners, particularly in facing the challenges or tasks that must be resolved in learning.
3. Effective

   It means, with active learning, creative and joyful can increase the learning effectiveness, which in turn can improve the quality of students' outcomes.
4. joyful

   It means, PAKEM model is designed to create a joyful learning atmosphere

The steps of PAKEM model learning according to Susanto (2013) which researcher applied in this study are as follows:

1. Review : teacher and students review previous material.
2. Development: the teacher constantly presents a new idea and expanding concept .
3. Controlled Exercise: teacher examines the misconceptions possibilities. It is recommended in group working.
4. Seat work: independent student or group in resolving issues / problem solving.
5. Individual/groups Reports: individual/group reports are reported for improvement needed.
6. Work display: the work is displayed which function as work appreciation at the classroom library / reading corner .
7. Giving homework for follow-up : homework should be corrected and valued .

III. RESEARCH METHOD

This study was a quasi-experimental study, design of the study was a one-group pretest - posttest. The population of this study was VIIIth grade student of one of junior high school in Batam, odd semester,2015-2016 academic year, while the sample was grade VIII3 students, they were 32 students. Sample technique was random sampling technique. The instrument used was the maths problem solving mastery test.

IV. RESULT AND DISCUSSION

In this stud, to determine the effect of the application of PAKEM model in learning used size effect equation which formulated by Cohen (1992)

$$\boldsymbol{d = \frac{\mu_{post} - \mu_{pre}}{\sigma_{pooled}}} \quad (\mathbf{1})$$

$$\boldsymbol{\sigma_{pooled} = \sqrt{\frac{\left(\sigma^2_{pre} + \sigma^2_{post}\right)}{2}}} \quad (\mathbf{2})$$

This equation was formulated to look at the effect size after treatment given, so that it needed to know the average value of class before (μ_pre) treatment given and the average value of the class after given treatment (μ_post) given. To determine the value of d, standard deviation was also needed before the treatment(σ_pre) given and standard deviation after treatment(σ_post) given. Categorizing the effect size toward concept understanding improvement by using the effect size formulation as follows .

Table 2. Effect size value criteria(d)

Value d	**Interpretation**
$0 \leq d \leq 0.20$	weak
$0.20 < d < 0.80$	medium
$d \geq 0.80$	Strong

source: (Rahmaniar & dkk: 2015)

After research conducted, to determine the effect size of the PAKEM model implemetation toward Mathematic Problem-Solving improvement, it was found result of the research which calculated using effect size formula as follows:

Table 3. Effect Size Of PAKEM Model Implementation On Improving Mathematic Problem-Solving Mastery recapitulation

N	μ_{pre}	μ_{post}	σ_{pre}	σ_{post}	Effect Size (d)
32	3.8	8.7	1.8	1	3.3

Source: (Rahmaniar dkk: 2015)

Based on the table, the researcher obtained the value of the effect size, 3.3, itindicates that the PAKEM model has a strong influence on improving students' mathematical problem solving mastery. The result was relevant to what Surantinah defines(in Ananda 2009: 6) that PAKEM Model is able to maximize problem solving mastery, and be able to compete, role actively, effectively , creatively and intelligently on improving problem-solving mastery within himsefl.

Figure 1 below, describes the effect size of the PAKEM Model implementation on improving mathematic problem solving mastery for each measured problem-solving mastery indicators, where the obtained effect size showed a strong influence too.

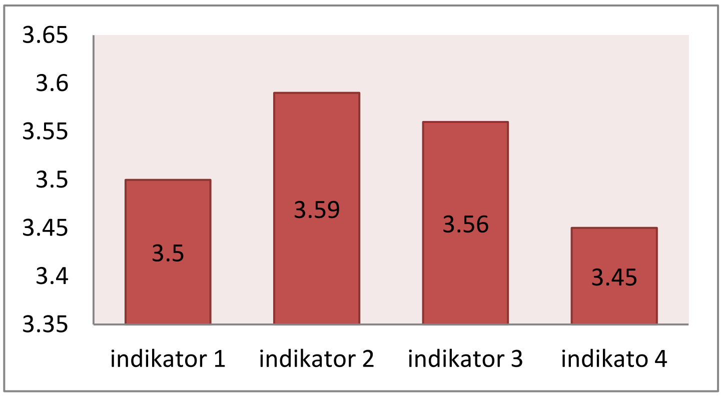

FIGURE 1. THE EFFECT SIZE FOR EACH INDICATORS

Information:
Indicator 1 : Understanding the problem
Indicator 2 : Choosing the suitable strategy to solve the problem
Indicator 3 : Resolving the problem correctly and systematically
Indicator 4 : Checking the accuracy of chosen strategy and the truth of problem solving gotten.

V. CONCLUSION :

PAKEM model has a strong influence on improving students' mathematic problem solving mastery in functions material. This is shown by the effect size achievement of 3.3 .

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ME – 52

Improving Students' Logical Thinking Mathematic Skill Through Learning Cycle 5E and Discovery Learning

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Abstract**—** This research is motivated by low of logical thingking mathematic skill junior high school students based on the results of the TIMSS 2011. This study aims to determine the increase logical thinking skill junior high school students who were taught by *learning cycle 5e* and *discovery learning*. This study is a quasi experimental and instrument of this research used the logical thinking skill tests include the skill to think mathematically proportional, probabilistic and correlational form of description as much as 4 questions that have been tested for validity and reliability. Population of this study is a junior high school students, the sample was taken two classes of ninth grade there is to be a experimental class 1 (using the learning cycle 5e) and experiment class 2 (using discovery learning). Before and after the experiment each class are given a pretest and posttest. Based on this research, it is known that there is no different improvement of students' logical thingking mathematic between students taught by using *Learning Cycle 5e* model and students taught by using discovery learning model.
Keywords: *Logical thinking Mathematic, Discovery Learning, Learning Cycle 5E.*

I. INTRODUCTION

Mathematics is the science which very useful for many people; therefore mathematics became one of the compulsory subjects that must be learnt by students at every level of formal education from elementary to high school. Mathematics and its learning are two things that can not be seen partially, due to the rapid of mathematics influenced by its learning in high school and college level. According to the Ministry of Education (2006), the aim of mathematics learning is to train how to think systematically, logically, critically, creatively and consistently [1].

The ability to think logically in learning mathematics is emphasized by every individual when need to take decisions, draw conclusions up to problem solving in everyday life sanely. The importance of the ability to think logically encountered in the vision and goals of mathematics teaching is to develop mastery of mathematical concepts, understanding and being able to apply mathematical concepts well in other subjects and in everyday life.

Apparently, based on the results of the study, mathematical logical thinking ability of students is still low. Lack of logical thinking ability of students can be seen from the results of the study by TIMSS in 2011. TIMSS is one of the international study to evaluate special education for the study of 14 year-old students at the level of junior high school (SMP), followed by Indonesia, where questions tested included measures of the students' ability to think logically. Rosmiati (2013) states that the average achievements of Indonesia on TIMSS 2011 is at a low level which is at rank of 386 and the mean of Indonesian participants' achievement has decreased from an average of the TIMSS 2007 which is the 397th rank [2].
Innovative and constructivism-based learning can be a solution to improve the ability to think logically for junior high school students. one of which is learning cycle 5E model. Learning Cycle 5E model aims to help developing students' thinking from concrete to abstract thinking. This model isnot only commonly used in the fields of science, but also is applied in mathematics. there are five phases in the Learning Cycle 5E model, namely engagement (attract attention-binding), exploration, explanation, elaboration (expansion), and evaluation.

Besides, learning model that can be used as a solution is discovery learning. Ruseffendi (2006: 329) argues that discovery is a method of teaching that is arranged normatively so that children can acquire the knowledge they do not know previously through their own effort and within their teacher's help[3]. As noted by Taba (Trisnadi, 2006: 21), the discovery method involves an inductive sequence. this sequence begins not with the explanation on a general principle but exposes students to some examples of principles where they can analyze, manipulate and experiment [4].

One of the advantages of learning through discovery learning is to lead the development of intellectual potential of students. By discovering relationships and regularities of the material being studied, the student becomes easier to understand the structure of the material being studied. So, students will more easily remember the concepts, facts, algorithms / procedures and principles in mathematics.

Based on the explanation above, the formulation of the problem in this paper is “Is there a significant difference in improvement on the logical thinking between students who use learning cycle 5e with those who use discovery learning?

II. THEORITICAL REVIEW

A. Mathematical Logical Thinking Ability

Logic can be defined as something that is in accordance with the logic, true by reasoning and reasonable. Logic in mathematics is often associated with the use of the rules of logic. Someone who played by the rules of logic can be said that the person is able to think logically. Saragih (2006) revealed that the logical thinking has differences with memorization [5]. Memorizing only refers to the achievement of a mere memory skills, whereas a more logical thinking refers to the notion of understanding, application ability, analytical skills, ability to synthesis, even the ability to develop skills evaluation (a process). Edward de Bono in Rosnawati (2011) divides the thinking patterns into a pattern of vertical and lateral thinking. Conventional patterns of thinking logically has been known and commonly used included into the mindset of vertical. This pattern of thinking is done step by step based on the facts to seek various alternative solutions to problems, and ultimately chose the most likely alternative according to normal logic[6].

In some discussions,the term of logical thinking (logical thinking) is often interchangeable with the term logical reasoning (logical reasoning) because both contain some similar activities. Indeed, the term logical thinking has a wider scope than logical reasoning . The term logical reasoning will contain activities to explain why and how a result is obtained or why and how to draw conclusions from available premises, or as a conclusion based on inference rule. While the term logical thinking load broader activities include completing mathematical problems in a rationally or reasonable (Sumarmo, 2011) [7].

Capie and Tobin (1980) in Sumarmo (1987) measure the ability of logical thinking based on the theories of mental development of Piaget to distinguish students stage of concrete operations and formal operations through the Test of Logical Thinking (Tolt) which consists of five components: Controlling variable , proportional reasoning, probabilistic reasoning, correlational reasoning, and combinatorial[8].

Logical thinking which the author want to examine adjusted with the level of junior high school students' thinking is the ability of probabilistic and correlational thinking, and the ability to think proportionately.

B. Learning Model Learning Cycle 5E

Learning Cycle model is a science-based contructivistic learning model. The model was developed by J. Myron Atkin, Robert Karplus and SCIs Group (Science Curriculum Improvement Study), at the University of California, Berkeley, USA since 1967. The theory of constructivism views that learning is a process of knowledge building bit by bit, which then the results are expanded through a limited context and it is not a sudden process. Knowledge is not a set of facts, concepts or rules that are ready to be retrieved or remembered. Man must construct knowledge and give meaning through real experience.

According to Soebagio, et al (2001: 50), Learning Cycle is a learning model that allows students to find their own concept or solidify concepts learned, prevent misconceptions, and provide opportunities for students to apply the concepts learned in new situations[9]. Learning Cycle model implementation in accordance with the view of constructivism learning where knowledge is built on self-learners.

The steps in each phase Learning Cycle 5E described by Lorsbach (2002) are as follows:

a. Engagement Phase. At this stage, the teacher prepare the students to learn, generate students' interest in math, and do a debriefing in exploring the students' prior knowledge. In the engagement phase, this interest and curiosity of the learners on topics which will be taught are tried to be resurrected. In this phase, learners are also invited to make predictions about the phenomenon to be studied and proven in the exploration stage.
b. Exploration Phase. At this stage, students work together in small groups to work on worksheets without direct instruction from the teacher. Students learn the concept itself from various sources and then discuss it with their friends n group..
c. Explanation phase. This stage is the stage of classical discussion. At this stage, the students explain the concept of the findings whitin their group with their own words, evidence and clarification of their explanations as well as comparing the arguments they have with the arguments of the other students.
d. Elaboration phase. At this stage, the students apply the concepts they got to solve the problems.
e. Evaluation Phase. Evaluation can be done through the provision of tests (quiz) or open-ended question at the end of the study to determine the extent of students' understanding of concepts learned, to evaluate the effectiveness of the previous phases and also evaluation of the knowledge, and to understand the concepts or competence of learners through problem solving in new contexts that sometimes encourage learners to investigate further[10].

Based on the stages in a cyclical learning method as described above, students are expected not only to hear the statements of teachers but it can also play an active role to explore and enrich their understanding of the concepts learned. Based on the above explanation, the learning cycle can be implemented in the areas of science and social.

Learning cycle should put forward because it is based on the learning theories of Piaget (Renner: 1988), constructivism learning theory. Piaget stated that learning is the development of cognitive aspects include: structure, content, and functionality[11].

C. Discovery learning

Discovery learning is a learning process in which a concept is not presented in the final form, but students are required to organize themselves in finding a way of learning concepts (Department of Education, 2013)[12]. Model Discovery learning is to understand the concept, meaning, and relationships, through an intuitive process to finally come to a conclusion. Discovery occurs when an individual is involved, especially in the use of mental processes to find some of the concepts and principles. Discovery is done through observation, classification, measurement, prediction, determination and Inferi. As a learning strategy, Discovery learning has the same principle as the inquiry and Problem Solving. There is no difference in principle on these three terms; Discovery learning is more emphasis on the discovery of concepts or principles that were previously unknown. The difference with the discovery learning is that the discovery problem that confronted the students is some sort of problem that is created by the teacher, while the problem in inquiry is not the result of the teacher's creation, so students have to put all of their effort, mind and skill to get the findings in the matter through the research process.

Problem Solving puts more emphasis on problem-solving ability. However, the principle of learning clearly visible in Discovery learning is that the material or learning material to be delivered are not delivered in final form, but students as learners are encouraged to identify what they want to know followed by finding the information them selves, then they organized and formed (constructively) what they know and they understand in a final form.

In the end, the objectives of the Discovery learning model proposed by Bruner is to let the teacher provides the opportunity for students to become a problem solver, a scientist, historian or mathematician. Through these activities, the students will master, implement, and find things that are beneficial to them. The most obvious characteristic of the Discovery as a model of teaching is that after the initial teaching levels (with the previous), teachers' guidance would be less involved compares with other teaching methods. It does not mean that teachers stop to give a guidance after the problems presented to students. The guidance given is not only reduced directly but students are given greater responsibility for their own learning.

The stages of discovery learning (Department of Education, 2013)

a. Stimulation (Giving Stimulation)

First of all, students are faced with something that causes confusion, then proceeded to not give a generalization, so that they have desire to investigate it by them selves. Besides, teachers can start teaching and learning activities by asking questions, suggestions reading books, and other learning activities that lead to the preparation of problem solving.

b. Problem Statement (Identification of Problems)

After stimulation, the next step is teachers allowed students to identify as much as possible the agenda of issues which relevant to learning materials, then one of them is selected and formulated in hypothetical form (temporary answer to the question problem)

c. Data Collection (Data Collection)

When the ongoing exploration happens, teachers also provide an opportunity for the students to gather as much information relevant to prove the correctness of the hypothesis. This stage serves to answer questions or to prove the truth of the hypothesis. Thus the students are given the opportunity to collect (collection) of various relevant information, read the literature, observing the objects, interviews with informants, do their own trials and so on.

d. Data Processing (Data Processing)

Data processing is an activity to process the data and information that has been obtained by the students through interviews, observation, and so forth, and then interpreted. All information results of readings, interviews, observation, and so on, are all processed, randomized, classified, tabulated, even it is calculated and interpreted in a certain way at a certain confidence level. Data processing is also called the coding / categorization that serves as the formation of concepts and generalizations. From generalizations, students will gain new knowledge about alternative answers / settlement that needs proof logically.

e.Verification (Proof)

At this stage, the students perform a careful examination to prove whether or not the hypothesis set forth earlier by finding alternatives, associated with the results of data processing Verification according to Bruner, aimed to make the learning process will go well and creative if the teacher gives students the chance to find a concept , theory, rules or understanding through examples that he encountered in his life. Based on the results of processing and interpretation or information, statements or hypotheses that have been formulated earlier was then checked, whether answered or not, whether proven or not.

f. Generalization (Interesting Conclusion)

generalisation / conclusion drawing phase is an interesting process that can be used as a general principle and application to all event or the same problem, taking into account the results of the verification[12].

III. RESEARCH METHOD

This study is a quasi-experimental research, with pretest-posttest control group design which used two classes as sample. The first class is the experimental class 1 that was taught using 5E learning cycle and the second group is the class that was taught using Discovery Learning and called as the experimental class 2. The population is one of the junior high school in Cimahi. Sample was selected 2 class from 9 class available. According Ruseffendi (2010) Design research is as follows [13]:

:

$O \quad X_1 \quad O$

- - - - - - - - - - - - - - - -

$O \quad X_2 \quad O$

Information :

O : pretest and posttest of mathematic logical thinking ability

X1 : Learning activity using learning Cycle 5E model

X2 : Learning activity using discovery learning model
------ : Sampling is not randomly taken

IV. DISCCUSION

Here are the finding of students' logical thihnking ability :

TABEL 1. Statistical description of Mathematic Logical Thinking Ability

Data	***Learning Cycle 5E***				***Discovery Learning***			
	Pretes	**Postes**	**Gain**	**N**	**Pretes**	**Postes**	**Gain**	**N**
$\bar{x}$	1.45	5.21	0.36	33	2.85	5.78	0.33	33
S	1.54	2.88	0.25		1.50	2.20	0.19	

From the data served in Table 1, it can be seen that the improvement of the mathematic logical thinking ability of the students who used learning cycle 5e is higher than those who used discovery learning (means of the gained score). Based on this finding, t-test is applied to examine the significant difference between the two means of score.

Tabel 2. T-test of Mathematic Logical Ability

Test	Sig	Finding	Interpretation
Gained mathematic logical thinking	0.588	Ho is accepted	There is no significant difference between the improvement of mathematic logical thinking ability of the students who used learning cycle 5e method and those who used discovery learning method.

From the finding obtained, there is no significant difference between those two methods. It means that both learning cycle 5e method and discovery method serve the same good effect on improving the students' logical thinking. It can be seen from the gained score of each method which comes to the average category.

Based on the data analysis above, it can be concluded that there is no significant difference on the students' mathematic logical thinking ability between the students who used learning cycle 5e model and discovery learning model. The two models are able to improve mathematic logical thinking ability of the junior high school students well.

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ME – 53

Multiple Mathematical Representation Profile of Grade VIII Based on Multiple Intelligences

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Multiple Abstract- *mathematical representation is important to be pondered Because It can enhance the student's ability to represent ideas in a variety of problem-solving solutions. When representing mathematical problems, each student will have a different profile Likely. The differences are possible due to different students have intelligence. This study Aimed to describe the multiple mathematical representations profile of the eight grade students based on multiple intelligences. This research is a descriptive qualitative research with three research subjects. The results Showed that the S1 outlined the process of working on each stage with the aim to explain and elaborate on her ideas to others. In working on this matter, S1 used equation by outlining every step of the process. This is in line with the student's character as the Linguistics Subject. S2 is incompatible with the possessed dominant intelligence. Because in children theory, those who have visual-spatial intelligence will be working in graphic. Consequently, S2 work using the equations were not thorough because she did not understand the meaning of the questions. S3 answered with a short way in accordance with the multiple intelligence theory that logical-mathematical subjects are in the high-speed counting. However in the ability of multi-representation, he can only express graphics and equations ideas but he has forgotten the graphic stage.*

Keywords: *profile, mathematic multiple representation, multiple intelligences*

I. INTRODUCTION

The transition from arithmetic to algebra is quite difficult for students because it requires students to make many adjustments even they are quite capable in arithmetic. Kieran (2004) suggested adjusting the algebra that focuses on relationships and not just counting numbers, focuses on representing and solving problems. Most of students, when given the algebra problem, they calculate it directly while abandoning an attempt to understand the meaning of the question, the relationship of each sentence so that they suffer from difficulties in solving problems and representing it. Dobrynina & Tsankova (Sukmawati, 2015) stated that to facilitate the transition from arithmetic thinking to algebraic thinking, the students should develop an understanding and possessing experience with the ideas from early algebra school.

Algebraic thinking skill is closely related to the mathematical representation because to be able to think well, algebra students should have good representation capabilities as well. The ability of a mathematical representation is one of the general purposes from mathematics learning at school. In thinking of algebra, students are able to do generalization ability, mathematical modeling and problem solving. To do all three skills in algebraic thinking, students need to be able to do multi-representation in the form of images, graphs, charts, and other forms of representation. With multi-representation, problems that are initially seem to be difficult and complicated can be seen more easily and simpler so that the presented issues can be solved more easily.

Based on Mudzakkir research (2006), the ability of junior high school students in Indonesia in representing ideas or mathematical concepts in the material of representing ideas or mathematical concepts in the division and numbers material, algebra, geometry, data representation, analysis and opportunities, are still regarded below the expectation. For instance, when students are asked to create a semblance of a table that represents the relationship between two variables, it turned out that representation ability of Indonesian students was 27%, while the ability of the international average is 45%. This is because Indonesian students are lack of ideas in expressing their opinion in solving mathematical problems.

In mathematical learning, when students are given a problem or question by the teacher, in resolving the issue, the students tend solve it in similar way as the examples that have been given by the teacher.

Consequently, students simply imitate and memorize the way the teacher resolves the issue. This is because they assume that the answers given by the teacher in the example is the only correct answer. Besides, the teacher does not attempt to provide answers about the possibility of more than one solutions, so that the students' ability to express ideas are low.

The ability of mathematical diverse representation is the ability to pour, state, translate, disclose or make a model of the ideas or mathematical concepts in new diverse mathematical forms. Some of diverse mathematical representation may be in form of charts, graphs, tables, expressions or mathematical notation and writing in their own language (Mudzakkir, 2006).

According to Pape & Tchoshanov (Luitel, 2001), there are four ideas that are used to understand the concept of representation, namely; 1) The representation can be seen as an internal abstraction of mathematical ideas or cognitive schemata built by students through experience, 2) as a reproduction of the mental from the mental state previously, 3) as a structured grain through images, symbols or emblems, 4) as the knowledge of something that represents something else. Based on the experts' opinion, it can be concluded that the ability of multi-representation is a student's ability to represent ideas in the form of charts, graphs, tables, mathematical expressions and words.

According to Ainsworth (Mehmet, et al, 2010), there are three main functions of multi representation, i.e., as a supplement in cognitive processes, helping to limit the possibility of misinterpretation, and building understanding of the concept in more depth. In addition to the above three main functions, multi representation also serves to explore the differences in the information declared by each interpretation. Multi representations tend to be used to complement each other where no single representation could not cover all delivered information. There are at least five important reasons of why multi representation is excellently useful for Mathematics learning, namely: 1) Learning multi representation helps learners who have different intelligence background. 2) The quantity and concepts of a physical nature can often be visualized and understood better by using representations. 3) Helping constructing other, more abstract representations. 4) Qualitative Reasoning is often aided by using a concrete representation. 5) an abstract mathematical representation can be used for quantitative reasoning which mathematical representations can be used to search for a quantitative answer to the question.

Chatib (2009: 12) stated that every person in the world has a basic character such as: different potential, interests and talents. This difference affects a person in perceiving and solving a problem. It means the student's ability to represent the problem depends on the individual ability relating to a person's intelligence. Because solving problems are important to be studied and in relation to the individual intelligence, researcher wants to know how the students' actual ability works in solving mathematical problems based on the dominant intelligence possessed by students.

II. RESEARCH METHOD

This study used a qualitative research with the descriptive qualitative as the method. This method is aimed to describe students' multi-mathematical representation ability based on their multiple intelligences. In the planning stage, the researcher compiles multiple intelligence tests to determine the subject of research, devises multi-representation test and interview. Phase of collecting data is using appropriate multi-representation test indicator and interviews. The main instrument is the researcher. In data analysis stage, the researcher uses reduction and conclusions, and also uses triangulation techniques.

III. RESULTS AND DISCUSSION

Result analysis for Representative Mathematical Ability Test

From the result of students' intelligence questionnaire, the researcher found three students based on the acquisition of three highest scores on the logical-mathematical, linguistic and visual-spatial. In this study, the researcher only limited on the three intelligence because the three intelligence that closely linked to mathematics is logical-mathematical, linguistic and visual-spatial. After getting the subjects, the researcher conducted a written test and interview on the algebra material. The list of students selected in table 1.1, namely:

Table 1. List of Name of the Selected Students

No.	Student's code	Type of Intelligence
1	S1	Linguistic
2	S2	Spatial
3	S3	Mathematic Logic

The multi-representation ability in this study is related to the Two Variables of Linear Equations material. The expected answer maybe in form of words, diagrams/ pictures, and also can be deciphered in accordance with the formula.

A. Analysis on Student 1 (S1) with Linguistic Intelligence

1. The ability of the linguistic intelligence

S1 represents students with intelligence Linguistics. Suparno (2003: 29) stated people with Linguistic intelligence has the ability to use language and words, both written and spoken in many different forms to express their ideas. They tend to be easier to learn by listening and verbalization. This ability is related to the use and development of language in general. People who have high linguistic intelligence will speak fluently, good and complete. It's easy to develop knowledge and language skills, it is easy to learn several languages. The person can easily understand the order and meaning of words in language learning, it is easy to explain and communicate ideas to others.

2. Result of the Student's Answer

The following is an analysis of the answers to the student's multi-representation ability based on test,

a. On the first question, S1 outlined using gradient formula to figure out the type of the equation slope 3 x + y = 4. Answer was disclosed properly.
b. The second question, S1 also outlined the answers based on worth properties. However, the solution was not appropriate. In step 3, S1 added a second segment with (-4). But the results in step 4, S1 should have subtracted both sides by (y). However, the right-hand side had just been added to the y. As a result, the value of y that should have ridden down, has ridden up.
c. S1 answer on this number was correct. With the same question a and b, S1 outlined answer according to the given equation to obtain the correct answer.

In general, S1 solve the problem by means of equations

Analysis of the results of interviews with student
T = So, is the slope positive or negative?
S1 = Negative Ma'am, this is -3.
T = That's right, where did you get -3?
S1 = From the m value ma'am. Because before -3 is x, so the results of its m is -3. is it is not?
T = Yes, it's true
T = now go to the question b, why is y = 11?
S1 = here is the way ma'am.
T = Try repeat the way again carefully and see whether the steps are correct.
S1 = according to me, it is true ma'am. It's a 3 x 5 + y = 4, so 14-4 = y, then y = 11
T = Oh really?, let's see the step three, it is true, see the next step, why is y moved to the right side?
S1 = both are equally minus 4 ma'am.
T = The one you substracted is only 4 right?
S1 = the left one also, it's a y- 4.

T = OK, take a look at this, the right-hand side is added by y? why is the left side y is missing? If both are added, both should be right 2y.

S1 = oh yes yes ma'am .. it is my mistake..y should be omitted

T = the correct one is 15+ y - 4 = 4-4, so 15 + y - 4 = 0, so 15-4 = -y

S1 = -y?

T = it is because it has moved sections

S1 = I dont remember ma'am

T = Question c is easy right?

S1 = yes ma'am, I could do it. This is -5 and it is inserted to the value of y, so, the x = 9: 3 = 3.

T = Absolutely.

3. Conclusion

Eventhough S1 student still made mistake in calculating the problem due to carelesness, but in the process of working, S1 outlined the process of working on each stage with the aim to explain and elaborate on his ideas to others. in working on this matter, S1 used equation in outlining every step of the process. This is consistent with the character of the student as the subject of linguistics. But in a multi-representation point of view, the student only worked on one idea, namely to the equation.

B. Analysis of Students 2 (S2) with Visual Spatial Intelligence

1. The ability of visual-spatial intelligence

S2 represents student with visual-spatial intelligence. Suparno (2003: 29) stated that the visual-spatial intelligence covers a person's ability to understand the relationship more fully between objects and space. Students have the ability, for example, to create a form of imagination in his mind or the ability to create three-dimensional shapes. The ability to imagine a tangible form and then solve various problems in connection with prominent ability is the type of visual-spatial intelligence. People who have good visual-spatial intelligence can easily imagine three-dimensional objects in the room, it can describe the position with good space, has an active imagination, can express ideas in a graph more clearly and concisely.

2. Result of the Student's Answers

The following is student's answer analysis to the multi-representation ability based on test.

a. Question a was answered very briefly. S2 immediately applied a gradient formula. Using the equation of the gradient, S2 changed the early equation form 3x + y = 4 to y = -3x + 4. So, the value of m was automatically the next coefficient x.
b. In question b, S2 misinterpreted the problem. The initial equation was added to 2 while principally, only the value of x was added 2. Consequently, S2 answer in this question was incorrect.
c. Question c was answered correctly. S2 used equation ways.

Here is the analysis of the results of the interview

T = is question a difficult??

S2 = No Ma'am. This one I can do it.

T = Besides this way, do you have another way?

S2 = Emmmm, another way? Well, Ma'am, I only know working with this way.

T = Yes, it is alright

T = How about question b? Why is the result like this?

S2 = I can't do it ma'am. I do not know how.

T = Look carefully at the question, what is it that you need to add?

S2 = if the value of x is added by 2, the value of x-right ma'am?

T = your understanding is correct, let's give it a try, where is x?
S2 = this, (pointing to equation in question)
T = Is that so? Try doing it again, 3x + y = 4. Are all of the values x?
S2 = oh yes, this equation yes ma'am, no x and no y. But I do not know how to add it.
T = the value of x only, the last x value is 3, if x = 3, what was the value in part A?
S2 = part A? If x = 3 then y = 4.
T = Now change the value of x to 5, because it is added by 2. Well?
S2 = please give me a moment ma'am ...so if x = 5, y = - 11. Right ma'am?
T = True. So, does the Y value ride up or ride down?
S2 = from 4 to -11, rides down right ma'am?
T = True. Be more meticulous yes...
T = How about question c?
S2 = I could do this. It is easy Ma'am, the value of y is replaced by -5, so the result is 3.
T = true.

3. Conclusion
Although the S2 intelligence that stands out is the visual spatial, but when working on the problems, she did not do it in accordance with the possessed dominant intelligence. Because in children theory, those with visual-spatial intelligence will be working on the problem in the graphic. Then S2 work using the equations were not thorough because she did not understand the meaning of questions so that the answers are wrong though in interview, S2 has just realized it.

C. Analysis of Student 3 (S3) with Logical-Mathematical Intelligence

1. The ability of logical-mathematical intelligence
S3 represents student with mathematical logical intelligence. Suparno (2003: 29) states that logical mathematical intelligence includes a person's ability to think inductively and deductively, according to the rules of logic to think, understand and analyze the patterns of numbers, and solve problems by using the ability to think. Students who have high mathematical logical intelligence have high-speed in counting and solving mathematical problems.

2. Results of the Student’s answers
The following analysis is the answers to the student's multi-representation ability to problems.
a. S3 solved question a with the equation. S3 transformed the original equation into the general equation for the gradient, i.e. y = mx + c. From the initial equation, y = -3x + 4 was obtained. Thus, the value of m was -3, with a kind of negative slope.
b. S3 misinterpreted the matter. The original equation was entirely written by 2. Thus the question b was answered wrong.
c. In question c, S3 directly substituted value of -5 to y. The answer was true.

In general, S3 has solved the problem using equations.

Here is the analysis of the results of the interview
T = is there a problem finding the slope?
S3 = my answer is negative. Because m = -3. I said this is not difficult.
T = Besides this way, do you have another way?
S3 = yes ma'am, I have been taught to use the puzzle line. But I forgot.
T = Yes, it is alright. Your answer is correct
T = How about question b? Why this?
S3 = I forgot ma'am.
T = Look carefully to the question, what is added here?
S3 = this one right Mom? This 3x is added by 2

T = your understanding is correct, try doing it again, but why do all the equations are added by 2?
S3 = I do not know how ma'am.
T = Yes very well then.
T = How about question c?
S3 = Yes, I know this one ma'am.

3. Conclusion
S3 as subject who has logical mathematical intelligence made a mistake in the second question because she misunderstood the meaning of the question. S3 used similarities and could use the graph but she has forgotten about the way. S3 answered with a short way in accordance with the multiple intelligence theory that logical-mathematical subject is very fast in counting. However, in multi-representation ability, she can only express ideas graphically and use equations but has forgotten the chart stage.

IV. CONCLUSION AND RECOMMENDATION

The importance of this study was to determine the student's multi-representation ability based on linguistic, visual spatial and logical-mathematical intelligence. By knowing these capabilities, the teacher can package the learning and teaching materials according to the ability and intelligence in expressing many ideas.

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ME – 54

Critical Thinking Skills Development Through Interactive Mathematical Learning Media

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Abstract—This research amis to design an interactive learning media in the subject of mathematics capita selecta, identify the beginning and ending of the ability of critical thinking math students. The method used is Research and Development, with the steps: identifying of teaching material that is given to subjects capita selekta mathematics, compiling teaching materials media interactive learning, designing interactive learning media, asking for consideration of experts, piloting interactive learning media and instruments research, initial tests critical thinking skills of mathematics, implementing of interactive learning media, the ultimate test critical thinking skills of mathematics. Data collection techniques include: test media interactive learning, critical thinking skill test mathematics. The research instrument is a matter of critical thinking skills math test. The population in this study is all students majoring in mathematics education of the third semester 2015-2016 academic year and the sampling used is cluster random sampling technique consisting of 3 classes. The results showed that the critical thinking skills of mathematics students with interactive learning media in Subjects Math Capita Selecta can be implemented in a lecture, the mathematics students early ability to think critically were on the low classification, while the ability of critical thinking of those at the end were in the medium. The highest average ability of the students in their critical thinking are on the indicators of inference and situation.

Keywords: *critical thinking skills of mathematics, interactive learning media, mathematics selecta capita*

I. INTRODUCTION

Education in Indonesia, especially mathematics education, in improving the quality of education need to hold new innovations in learning, human resource development, as well as in the fulfillment of the educational facilities. In connection with the development of human resources, the learning process plays an important role in improving students' critical thinking skills of mathematics. This is consistent with the purpose of the Faculty of Education (Guidance and Counseling) Siliwangi University in Tasikmalaya is to prepare personnel of teachers in middle and high school, according to the needs of both quantity and quality. While one of the missions of Mathematics Education courses FKIP Sliwangi University is organizing a quality education to prepare educators in the field of mathematics professionals. Based on this, students in Mathematics Education courses as mathematics teacher candidates need to prepare themselves maximally to be able to fulfill the mission of Mathematics Education courses. Therefore, one of the subjects that a provision student teachers in middle and high school is Math Capita Selecta. The scope of the course includes: the essential topics in middle schools which have common misconception, or a topic that is considered to be difficult for students in secondary education and further.

The use of instructional media is one of the alternatives in the development process of learning to be better.

Munadi, Y (2008) argued that the position of instructional media is to serve the learning needs of students / students. Through the use of instructional media, students are able to understand certain materials that seem abstract and not easily visualized independently. Interactive multimedia applications in mathematics learning is one form of innovation (product technology) in education. This will impact on beneficiaries or users of these innovations, namely education stakeholders including students. An acceptance of an innovation become very complex dueto the diversity of perceptions, backgrounds, and interests of users of innovation itself.

The results of previous research had an impact quite well that the teaching materials interactive media give the students facility to learn more independetly. Currently, some means based on information and communications technology (Information and Communication Technology / ICT) supporting lthe teaching learning process has been available. Regarding to the development of information technology so rapidly, teaching materials can be presented with sounds and images dynamically, not boring, as well as solid information. Therefore, the development of ICT-based learning is expected to improve the quality of the learning process in the classroom. UNESCO 2002 states that the use of ICT in teaching has three objectives: 1) to build a "knowledge-based society habits" such as problem solving skills (problem solving), communication skills, ability to find / manage information, transform that information into new knowledge and inform others, 2) to develop the ability to use ICT or "ICT literacy", and 3) to improve the effectiveness and efficiency of the learning process.

The use of interactive media in the learning mathematics in the classroom is expected to attract students' interest and motivation to improve their academic achievement. Learning math using interactive media is one form of realization of the curriculum in Mathematics Education courses and development courses Mathematics Instructional Media. Students are expected to participate actively and learn independently on Mathematical Capita Selecta to develop their critical thinking skills in mathematics.

In learning mathematics, the applications of interactive multimedia can be used in presenting the concepts and high-level skills in mathematics, which is connected between one element and the other which is difficult to teach and learn through books. These applications have advantages in explaining a concept. Therefore, the students are expected to be able to explore and analyze, try and explore the concepts and principles contained in the material, so it is relatively faster to build a structure of students' understanding. This is because of the integration of several components such as sound, text, animation, pictures / graphics, and video functioning to optimize the role of the senses in receiving information into the system memory. Nowadays, in some lectures there are still many lecturers who still use ordinary teaching learning conducted without the help of interactive media, so it can not provide the opportunity for students to explore and develop their creativity. Therefore, the development of interactive instructional media is predicted to facilitate students to develop high-level thinking skills independently, one of them is the critical thinking skills of mathematics. Regarding this problem, the authors are interested in carrying out research entitled "Critical Thinking Skills Math Students through Media Development Interactive Learning"

The purpose of this study is to identify the elusive teaching materials, the characteristics of critical thinking skills of mathematics, and the initial conditions of students. In addition, it is to design interactive teaching materials that contain critical thinking skills to facilitate self-learning mathematics students at Mathematical Capita Selecta Course. The outcomes of this study is media interactive learning software at Mathematical Capita Selecta Course.

II. Some Relevant Studies

Research on Media Education, which has been previously conducted by the research team comprising of Sri Wardani, Ipah Mudzalipah, and Edi Hidayat. The study, entitled "Development of Media-Based Learning Interactive Multimedia to Facilitate Self-Study Students on Course Capita Selecta Mathematics (Research on the Ability Understanding and Troubleshooting Mathematics Student Mathematics Education FKIP Siliwangi University in Tasikmalaya) concluded that the design and development of media-based learning multimedia interactive to facilitate students to learn independently and provide the opportunity to develop the ability of understanding and problem solving mathematic, instructional media based interactive multimedia sufficient quality makes it feasible to use student of mathematics learning courses mathematics capita selekta, and media-based learning interactive multimedia positive effect on the ability of understanding and solving mathematical problems students of mathematics education. Other studies are Kusuma (2008, 2009) states that (1) a computer-based interactive learning can be presented in an interesting, efficient, and effective interaction patterns tutorials, simulations, or games; (2) Development of a model-based learning e-Learning improve high-level mathematical thinking skills; and (3) increasing the capacity of reasoning, communication, connection, problem solving, critical thinking, and creative thinking mathematically through learning computer media better than students in the regular classroom learning; (4) the implementation of the use of computer media can significantly increase positive attitudes and interests of students in learning mathematics

III. Theoretical Review

A. Media Pembelajaran Interaktif

Media in the learning process tends to be interpreted as graphics tools, photographic, or electronically to capture, process, and reconstruct the visual or verbal information (Arsyad, 2007). With the presence of media in learning, students can learn the material independently and provides an opportunity to discover mathematical concepts and develop their creativity. Media are classified into five groups: (1) human-based media (teachers, instructors, tutors, role playing, group activities, field-trip); (2) print-based media (books, guides, exercise books (workbooks), work tool, and loose pages); (3) visual-based media (books, work tools, charts, graphs, maps, drawings, transparencies, slides); (4) based on audio-visual media (video, film, slide-tape program, television); and (5) computer-based media (computer aided teaching, interactive video, hypertext). In mathematics, interactive media helps students understand the various materials that seem to be abstract independently. Sutopo (2003) in Samsudin, A. (2008), suggests a media presentation could use some kind of text, charts, audio, video, animation, simulation, or photos. If these kinds of components (text, charts, audio, video, animation, simulation, or images) can be combined interactively, it can produce an effective learning.

This study uses presentation media in the form of random (non-linear), as one form of interactive video (interactive video). This learning media according to Seels & Glasgow (Arsyad, 2007) belongs to the type microprocessor based on cutting-edge technology media selection. Cutting-edge technology itself is divided into (1) a media-based telecommunications, such as teleconference , distance learning, and (2) a media-based microprocessor, such as computer-assistted instruction, computer games, the tutor intelligent system, interactive, hypermedia, and compact (video) disc. Preparation of the learning process through interactive media begins to prepare the material that will be taught to the following practice questions that contain critical and creative thinking skills in the form of interactive animated video. In the learning process, students learn to interact with the computer and mathematical concepts independently. Lecturers act as a resource and motivator. Another thing that needs to be done for learning through interactive media does not mean just learning entirely by computer, but it must remain the guidance of the lecturers so that the effectiveness of the use of interactive media is maintained. While interactive media can serve as instructors and facilitate self-learning students regarding to the procedures to be performed

B. Kemampuan Berpikir Kritis Matematik

Learning mathematics can not be separated from the process of thinking. Thinking involves two major aspects of critical and creative. Both thinking use reasoning to build a variety of ideas. According to Fisher (1995) thinking happens in every human mental activity that serves to formulate or solve problems, make decisions, or gain understanding. Judging from the dimensions, Marzano et al. (1989) argues that thinking includes five dimensions of metacognition, critical and creative thinking, thinking, thinking ability of the core, and the relationship between thinking with particular knowledge. In line with these opinions, Fisher (1995) suggested, thinking involves critical and creative aspects of the mind, and both are used in reasoning and build ideas. In addition, thinking is involved in any mental activities that help to formulate or solve a problem, make a decision or to build understanding, and then through thinking, it can interpret something.

Ennis (1981) defines critical thinking is a thinking process with the aim of making sensible decisions about what is believed to be or to do. More Ennis (1981) suggests there are six basic elements of critical thinking that is Focus (focus), Reasons (grounds), Inference (concluded), Situation (situation), Clarity (clarity), and Overview (holistic view). According to Baron and Sternberg (1987) there are five keys in critical thinking that is practical, reflective, reasonable, beliefs, and actions. The five keys to be combined into a definition for critical thinking, so what is meant by critical thinking is a reflective mind that is focused on deciding what is believed to be or do. In addition, the notion of critical thinking is something reasonable, reflective thinking that is focused on what is believed to be the decision, done, or done (Marzano et al., 1989).

IV. RESEARCH METHOD

The population in this study is all students of Mathematics Education FKIP Siliwangi University who join the course Math Capita Selecta. The sampling technique used is cluster random sampling. The method used in this research is development research. Procedures in developing interactive learning media include: analysing of the needs of students in the upper division courses, designing the teaching material in writing, asking the expert judgment of teaching materials, revising based on the input of experts, designing interactive learning media, asking for expert judgment interactive media, revised, limited testing, analysing of the trial results, revising, and earning media interactive learning mathematical prepared empirically tested and implemented in the learning of mathematics

V. Research Findings and Discussion

The analysis of the initial conditions of students in mathematics education courses are students who have a grade point average (GPA) average of 3.07. The age of students who will be the population is between 19-21 years. At this age, students have to know the device and use computers or the Internet for information on the results of faculty trustee is not a single person who does not have a social networking account. Interactive mathematics learning media form of teaching materials Course Mathematical Capita Selecta covering materials: operating the algebra, determining factors tribes algebra, completing the operation fractional algebraic form and function, declaring eligible tested empirically to students outside of the sample in the learning process Course capita Selecta and received a positive response from the students. They are motivated and enjoy learning math through interactive learning media. This is according to the research conducted Sudirman, Hermawati entitled Development of Interactive Multimedia Subjects Mathematics at the high school level Class X in Bandarlampung. Another study is Kusuma (2008, 2009) states that (1) a computer-based interactive learning can be presented in an interesting, efficient, and effective interaction patterns tutorials, simulations, or games; (2) Development of a model-based learning e-Learning improve high-level mathematical thinking skills; and (3) increasing the capacity of reasoning, communication, connection, problem solving, critical thinking, and creative thinking mathematically through learning computer media better than students in the regular classroom learning; (4) the implementation of the use of computer media can significantly increase positive attitudes and interests of students in learning mathematics. Based on the results of experts considered that the question of mathematics critical thinking skills, a decent used as an instrument to measure the ability after going through several revisions.

VI. Conclusion

The results showed that the previous ability of the student critical thinking inmathematics at Capita Selecta Mathematical Subjects that are in low classification, though individually some students are at very high and high qualification. The test results critical thinking skills mathematical conducted on 110 students obtained a mean score of 11.66 out of a maximum of 24. This was her ideal because students are not familiar with the form of critical thinking skills about mathematics even though no notification before critical thinking skills tests were held mathematic students, including qualifications less, classically weak on every indicator of the critical thinking skills of mathematics. The difficulties faced by the students are clarity, reason, dan overview. Students' clarity is the weakest indicator, meaning that students can not change habits in resolving the matter. Usually students to solve problems with a short way without clearly outlined, whereas the indicator clarity students are required to solve problems as clearly as possible and step sequences and complete. While the results of critical thinking skills of mathematics with the largest average obtained is the indicator Inference and situation.

Interactive learning mathematics media are tested empirically feasible to students outside of the sample, which will be implemented in the learning process Math Capita Selecta Course. Media are fit to use based on the analysis of experts and limited testing. Similarly, critical thinking skills mathematical instruments to be eligible to be continued to test empirically based on consideration of the experts and the limited trial.

Acknowledgments

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ME – 55

Development of Measurement Model Construct Student Persistence of the Open Learning University (UT)

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Abstract – This study was conducted to build the measurement model constructs UT student persistence by using structural equation modeling (SEM). There are two reasons, first their level of UT student persistence is very low. Second, student persistence can be defined by many things and is very complex, particularly for distance education student persistence. From the results of the study of existing literature, student persistence construct contains three dimensions: the dimensions of goal commitment, academic integration, and social integration. Then developed items that are used to build the model's baseline measurement of student persistence constructs. This study uses empirical data derived from 1876 students of UT and the second order confirmatory factor analysis obtained some value statistical goodness of fit is still not fit ($\chi2$=752.748; p=0.000; GFI=0.932; AGFI=0.909; TLI=0.589; and RMSEA= 0.059). With the assistance of modification indices contained in the package IBM SPSS AMOS, the model has been modified twice. The last measurement model of student persistence construct has a statistical value $\chi2$=83.803; p=0.001; GFI=0.991; AGFI=0.982; TLI=0.939; and RMSEA=0.020. By using the existing empirical data, the dimensions of goal commitment, the dimension of academic integration, and social integration are significant dimensions in the measurement model UT student persistence construct.

Keywords*: persistence, goal commitment, academic integration, social integration, distance education, measurement model, cfa, sem, goodness of fit*

I. INTRODUCTION

The Open Leraning University (UT) is different from other ordinary college, because UT implementing distance education system (ODL) and the system of openness [1]. System of distance education implies that the learning process is not limited by space, time, and particular media. To conduct learning activities, UT students do not need to come to a place or particular room, and also do not have to learn at a particular time. UT students can learn wherever they are, and at the time whenever he wants. They can learn in accordance chance they had. How to learn they are not done face to face but using multimedia, both printed material (learning modules) and non-printed material (audio/video, radio/TV, computer/internet, and other media).

Open systems (openness) implies the existence of a very high flexibility of learning for students or prospective students. Anytime, they can register as UT students, without any age limit, year diploma, learning time, time registration, subjects were registered, the frequency of exams, and so forth. In fact they may withdraw from UT any time. If they want to sign up again, all subjects who've taken and passed still be calculated in credits. UT does not require any in recruiting students. To become a UT student is minimal of prospective students have completed secondary education (high school or its equivalent). The logical consequence of the nature of the UT implementing distance education system (ODL) and open systems (openness), it is a very high rate of students who did not re-register or dropped out.

Although the UT system does not recognize the system of "dropping out", the number of UT students who do not re-register recorded quite high which is approximately two-thirds. UT students who do not re-register is not expressed as a student dropouts. Nevertheless, if the UT students do not re-register for four consecutive registration period, then they are declared as inactive students or passive students [2, 3, 4, 5]. The high number of UT students who do not re-register it, reflecting the low persistence of UT students learning.

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The low resistance student learning in distance education compared to face to face education, according to Belawati [6, 7], will become a major issue in the distance education system (ODL) for two reasons. The first reason~~,~~ is distance education offers alternative learning methods to overcome the constraints of time, economics, and demographics. Strength of this alternative learning methods mainly lies in their flexibility characteristics, transparency, openness, and cost-effectiveness. With these characteristics of distance education institutions provide vast opportunities for everyone, who for various reasons their limitations, and do not reach the regular higher education institutions. With these reasons, they have the perception that higher distance education becomes a second choice educational institution.

The second reason to pay more attention to the low level of resistance of learning in distance education, is having a great influence in the operations of the distance education institutions. The management of distance education institutions become inefficient and failed to become a provider of higher education with a large students capacity.

In general, this paper wants to build a measurement model of UT student learning persistence constructs by using structural equation modeling (SEM). To develop persistence constructs in this study, should be reviewed in advance understanding of the persistence operationally and dimensions that make up the construct.

II. PERSISTENCE DEFINITION

In general, the persistence of student learning can be defined as the durability of a student in the education program at an institution that implements a certain system. Other terms that are often used for a similar purpose with persistence is durability, resistance, retention, attrition, completion rate, course completion, and dropout. Understanding the persistence of learning in an educational system is also often interpreted as "pass" or "fail" of an educational program [3, 8, 9, 10, 11, 12, 13].

Many factors can influence the persistence of a student's learning. Enlarged students are passive, not only means imply a further weakening of durability (persistence) of students learning, but also provide an indication of something that do not fit or are not suitable for students. The emergence of a mismatch is determined by many factors. This mismatch is not only influenced by internal factors of students, but is also influenced by environmental student factors, and institutional factors where they studied. For example, the services provided by UT institutions can affect students in continuing studies.

The persistence of student learning in the distance education system is a very complex phenomenon, because it is determined by various factors that influence each other [7, 10, 12, 14]. By adopting a model which has been developed by Tinto [15], and a study conducted by Sweet [12] says that the persistence of student learning Open Learning Institute (OLI) Canada is determined by four sets of main variables, namely: (1) the characteristics of student background, (2) the integration of academic, (3) social integration, and (4) the orientation attitude. As a criterion variable is the persistence of OLI student learning, as indicated by the level of completion of the course (course completion).

Consistent with studies conducted by Sweet [12], a study by Kember [14] has also adopted and adapted the models from Tinto [15] and Spady [16] to analyze the persistence model of student learning ODL system. He states that the students' learning persistence can be expressed by dropping out of college and completing the course (course completion) [14]. According to Kember [14] dropped out of the distance education system is determined by many factors interrelated and highly complex. Framework of the models of dropping out of college or the persistence of student learning is the result of the combined effect of the four main variables (four stages). The first main variable in the Kember model is learner characteristics (student characteristics), including ethnicity, gender, family background, home, work, and education. The second major variable is the commitment to the goal (goal commitment), including intrinsic and extrinsic goal. The third major variable is the environment of academic and nonacademic student (academic and social environment), and the fourth main variable is the integration of academic and nonacademic (academic and social integration).

Based on cultural factors, institutional, educational and background UT student, studies to assess the effectiveness of interventions to improve student persistence at UT has been done by Belawati [6]. Intervention is given to preparing students to be familiar with self-learning system and improve service to students who have the time and resource constraints. There are five kinds of interventions are being tested to see the effect on student persistence, namely (1) a welcome letter and written instructions (welcome), (2) a schedule reminders (reminders), (3) a letter of encouragement (encouragement), (4) a brochure about learning strategies independent (brochure), and (5) a list of names and addresses of students of the region UPBJJ (peers). Experiments in the field involve new students in 1102 than 8981 regular program (Science, FEKON, and Social) that register until September 1993. The variable persistence is measured by (1) Independent Task collection rate, (2) the presence of the test, and (3) the level of re-registration of the second semester.

The results showed that the intervention was not significantly increase student persistence. Variable number of courses and employment status seems a little more influence persistence than the interventions. Another result is that the collection rate student Independent Task high and also high levels of participation test, it seems faster to re-register the second semester. Interventions are still not able to accommodate the needs of students who used the direct guidance [6].

The possibility that a student completes his education through UT can be achieved either continuously or intermittently re-registration between the registration period (semester) to complete his education at UT. Nevertheless, in the management or administration UT guidelines stated that when a student at least four times the continuous registration period (semesters) did not re-register, then the student is declared as a passive student. They will be treated as a new student with student registration number (NIM) new registration if they do come back. Although initially a passive student, according to a regulatory filing the number of courses or credits that have been taken and passed still recognized by UT and will be taken into account in the acquisition of cumulative semester credits [5, 17].

The whole terms related to student learning persistence giving the impression that there is a group of students who continually able to survive and finish their education. On the other hand, there are groups of students who falter in completing their education. One characteristic of education completion at a distance education institutions is by registering or connecting from one semester to the next semester.

The persistence of student learning in distance education is a complex phenomenon and determined many interrelated variables. The persistence regarding the psychological aspect which is a function of the interaction of individual, academic, and environmental [6, 7, 12, 14]. They believe that a student will tend to have a high resistance when the condition of the student matches the academic and environmental conditions. In the ODL system, nonacademic conditions also contribute a very dominant than the face-to-face system. A Kember model [14] has adopted a Tinto model describe the phenomenon of persistence in learning the ODL system in Figure 1.

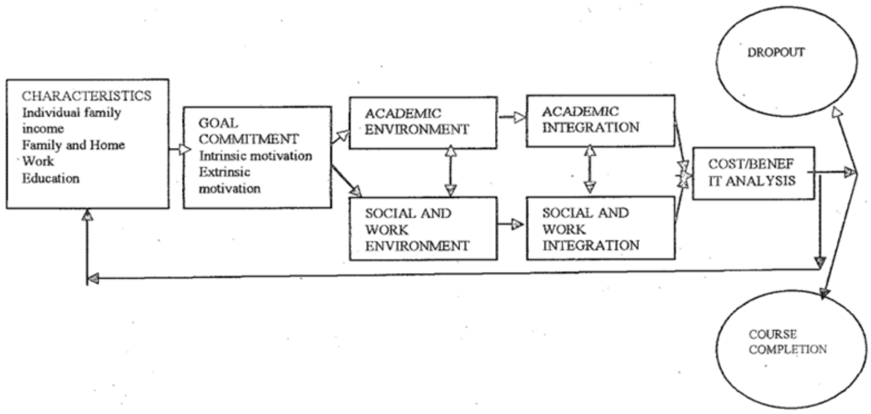

Figure 1: Kember Model about Student Persistence of ODL System

From the Kember models, in determining the persistence of learning contains dimensions: (1) commitment to the goal (include intrinsic motivation and extrinsic motivation), (2) academic integration, and (3) social integration. The process of integration between the individual, academic, and non-academic environment (social) had started when students enter a program ODL. If the condition of the environmental commitment and the commitment of academic institutions match, the students will feel safe to learn, which means that its persistence is quite high [6, 14, 18].

From the study of literature and explanations above we can conclude that the persistence of learning can be viewed as a continuum psychological aspects, from pole to pole, persistent until not persistent. Thus persistence of student learning is better seen as something that is dynamic rather than static. The model describes the relationship of the three dimensions of the UT student learning persistence construct presented in Figure 2.

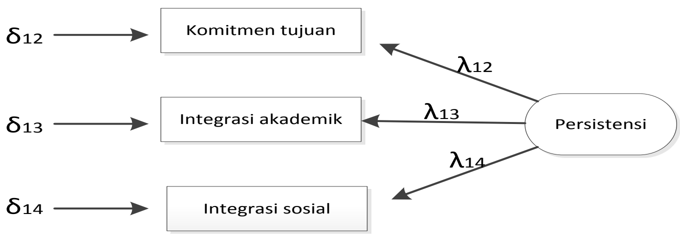

Figure 2: Measurement Model Construct Persistence of Student Learning

III. METHODS

A. Participants.

The data collection was conducted from January 2015 until October 2015 and collected as many as 1876 UT student respondents spread across 14 UT Regional Centers (UPBJJ UT). Characteristics of the students in this study are presented in Table 1.

Table 1. Participants Characteristics

Variable		**Category**	**Frequency**	**Percent**
Group	1.	Regular students	618	32.9
	2.	Basic education students	1258	67.1
Faculty	1.	FEKON	278	14.8
	2.	FMIPA	184	8.8
	3.	FISIP	156	8.3
	4.	FKIP	1258	67.1
Gender	1.	Male	430	22.9
	2.	Female	1446	77.1
Marital status	1.	Married	1054	56.2
	2.	Not married	822	43.8
Job status	1.	Not yet working	336	17.9
	2.	Already working	1540	82.1
Highest Diploma	1.	SMTA	1131	60.3
	2.	D1-D2	216	11.5
	3.	D3-Sarmud	66	3.5
	4.	S1-S2-S3	463	24.7

B. Instrument.

Instruments to measure the construct of the persistence of student learning in this paper is one of the five constructs developed for dissertation research. There are five constructs developed by researcher: the construct of the internal environment of the student, the constructs of the external environment of the student, the construct of academic services, the construct of administrative services, and the constructs of the persistence of student learning.

UT student learning persistence is measured by three dimensions: the commitment to goals, the integration of academic and social integration. Dimensions commitment to goals is a commitment to the objectives of students attending UT. Dimensions academic integration of students is an attempt to integrate itself with the environmental conditions of academic institutions in order to remain in the process of completion of the program. Dimension of social integration is an effort student to integrate himself with the social environment around him to keep trying to complete the program.

To achieve the level of content validity and construct validity was good, the relationship model between constructs, dimensions, and items of instrument of measuring persistence construct is studied through focus group discussion (FGD) involving 9 raters (6 ODL experts and practitioners, 2 experts measurement, and 1 linguists). The resulting is an instrument contains items using a Likert format with 4 scale with a positive direction. Before it is used to collect data in the field, the instrument that results of the rater validation is tested to some UT students. The final result of the instrument measuring UT student learning persistence constructs are presented in the Appendix. The results of the validation and testing instruments to student persistence constructs are summarized in Table 2.

Table 2. Validation and Tryout Results of Student Persistence Construct

Dimention	**Validation**		**Tryout**		**Final**	
	Items	**Total**	**Items**	**Total**	**Items**	**Total**
Goal Commitment	B1-B9	9	B1-B6	6	B1-B6	6
Academic Integration	B10-B18	9	B7-B12	6	B7-B12	6
Social Integration	B19-B24	6	B13-B17	5	B13-B16	4
Total		24		17		16
Cronbach Alpha		0.896		0.756		0.702
Content validity (V Aiken) min		0.593				
Validitas validity (V Aiken) max		0.852				
KMO				0.687		0.788
Participants		9 raters		96 Students		1876 students

C. Analysis.

Data were analyzed by using a second order confirmatory factor analysis (CFA). Software IBM SPSS AMOS version 23 is used to assist the processing of this data. Because the data collected an ordinal scale data and shows no multivariate normal distribution, then the parameter estimation method used is asymptotically distribution free (ADF). The ADF estimation methods have properties that are more flexible compared to other methods that generally require multivariate normal distribution of data [19, 20, 21]. Testing suitability of measurement models used to test the goodness of fit to see the value of chi-square statistic, probability, goodness of fit index (GFI), adjusted goodness of fit index (AGFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA). Up to now there is no single statistic that can describe exactly match the measurement model, therefore it is necessary to use some of the above statistics [19, 21]. Small statistical value for chi-square and RMSEA showed that the model fit. Meanwhile for GFI statistics, AGFI, and TLI is expected to be large, indicating a more suitable models. Rule of the thumb for RMSEA is worth under 0:08, while for GFI, AGFI, and TLI is valued at over 0.9 [21, 22, 23].

IV. RESULTS AND DISCUSSION

In general, the development of persistence constructs measurement model of learning is determined by the value of the test statistic goodness of fit and value of standardized regression weights. Statistical existing empirical data. The value of standardized regression weights greater indicates that the items relationship to dimension, or dimensions to construct the relationship is getting stronger. Recapitulation of the value of standardized regression weights model development is presented in Table 3.

An early model (Model A) on the development of persistence constructs measurement model study showed results that do not fit. This is shown by the statistic $\chi^2 = 752.748$ and $p = 0.000$ that is still great value and statistical value TLI=0.589 which is still very small compared with the rule of the thumb. Statistic who already meet the rule of the thumb is GFI, AGFI, and RMSEA. To decrease the value of statistical χ^2 and raise the value of TLI should be done by modifying the model. There are three strategies that can be chosen to modify this model, which is confirmatory modeling strategy, competing modeling strategy, and development model strategy [21]. In order for this construct measurement models to be better able to use the results of the output modification indices. Nevertheless, consideration in terms of the theory remains the most important thing rather than just a statistical considerations [19, 21, 24].

Tabel 3. Standardized Regression Weights and Goodness of Fit

Construct/ Dimentions		Dimentions /Items	Model A	Model B	Model C
Persistence	→	GC	0.756	0.824	0.810
Persistence	→	SI	-0.398	0.784	0.695
Persistence	→	AI	0.905	0.919	0.937
GC	→	B01	0.633	0.609	0.612
GC	→	B02	0.615	0.598	0.604
GC	→	B03	0.540	0.624	0.631
GC	→	B04	0.557	0.627	0.628
GC	→	B05	0.411	0.405	0.393
GC	→	B06	0.552	0.603	0.609
AI	→	B07	-0.146	0.617	0.651
AI	→	B08	-0.119	0.554	0.560
AI	→	B09	-0.101	0.160	0.256
AI	→	B10	0.885	Remove	Remove
AI	→	B11	-0.011	0,061	Remove
AI	→	B12	0.930	Remove	Remove
SI	→	B13	0.601	0.674	0.672
SI	→	B14	0.478	0.613	0.596
SI	→	B15	0.402	0.494	0.498
SI	→	B16	0.038	0.280	0.158
Goodness of Fit					
Chi-square			752.748	195.453	83.803
p			0.000	0.000	0.001
df			101	64	47
GFI			0.932	0.979	0.991
AGFI			0.909	0.966	0.982
TLI			0.589	0.818	0.939
RMSEA			0.059	0.033	0.020

The next model (Model B) on the development of persistence constructs measurement model is to modify the initial model by removing the items and connect between error items (covariance). First, item number 10 (participation activities online tutorials or B10) and the item number 12 (the assignment online tutorial or B12) are excluded from the measurement model. The reason is the online tutorial activity is only given to UT regular students (nonpendas), while the UT basic education student (pendas) until 2015 (when the data collection) has not received an online tutorial services. While the participants involved in this study the majority (67.1%) are UT pendas students. Item B10 and B12 is only relevant for UT nonpendas students. So the academic dimension of integration (AI) was measured with four items.

The second modification is to connect between error items that are still in one dimension. Considerations that are used to connect between error items is modification indices, and considered as the linkages aspects of the content of the items. For the dimension of goal commitment (GC), error items that are linked is erB01-erB02, erB03-erB04, erB03-erB06, erB04-erB05, and erB05-erB06. For the dimension of academic integration (AI), error items that are linked is erB07-erB09 and erB08-erB09. For the dimention of social integration (SI), error items are linked is erB13-erB16, erB14-erB16, dan erB15-erB16.

Development of persistence constructs measurement model of learning (Model B) shows the results are quite fit. This is shown by the statistic value $\chi^2 = 195.453$ and $p = 0.000$ are getting smaller and statistical value TLI=0.818 which greatly improved although not yet reached the value that has been set. Statistics who already meet the rule of the thumb are GFI, AGFI, and RMSEA.

To get a measurement model that is more suitable constructs persistence again, built a model other alternative measures (Model C). Modify the model by removing items and linking error items from a dimension with error items other dimensions (Fig 3). In this model, the item excluded is item B11 (face to face tutorial tasks) for the value of the coefficient lambda is too small and no significant. Output modification indices and the content of any items taken into consideration for connecting between the error items. In the measurement model constructs persistence of this study, errorr items correlated are erB07-erB16, erB08-erB16, erB09-erB14, and erB09-erB15. Parameter estimation results in the form unstandardized regression weights for Model C are presented in Table 4.

Table 4. Unstandardized Regression Weights

			Estimate	S.E.	C.R.	P	Label
GC	<---	Persistence	1,000				
SI	<---	Persistence	1,673	,127	13,138	***	par_10
AI	<---	Persistence	1,327	,103	12,855	***	par_11
B06	<---	GC	1,082	,058	18,723	***	par_1
B05	<---	GC	,748	,062	12,012	***	par_2
B04	<---	GC	1,129	,062	18,271	***	par_3
B03	<---	GC	1,367	,078	17,634	***	par_4
B02	<---	GC	1,065	,045	23,717	***	par_5
B01	<---	GC	1,000				
B08	<---	AI	,871	,064	13,545	***	par_6
B07	<---	AI	1,000				
B16	<---	SI	,294	,065	4,520	***	par_7
B15	<---	SI	,721	,041	17,536	***	par_8
B14	<---	SI	,859	,048	17,948	***	par_9
B13	<---	SI	1,000				
B09	<---	AI	,255	,046	5,602	***	par_14

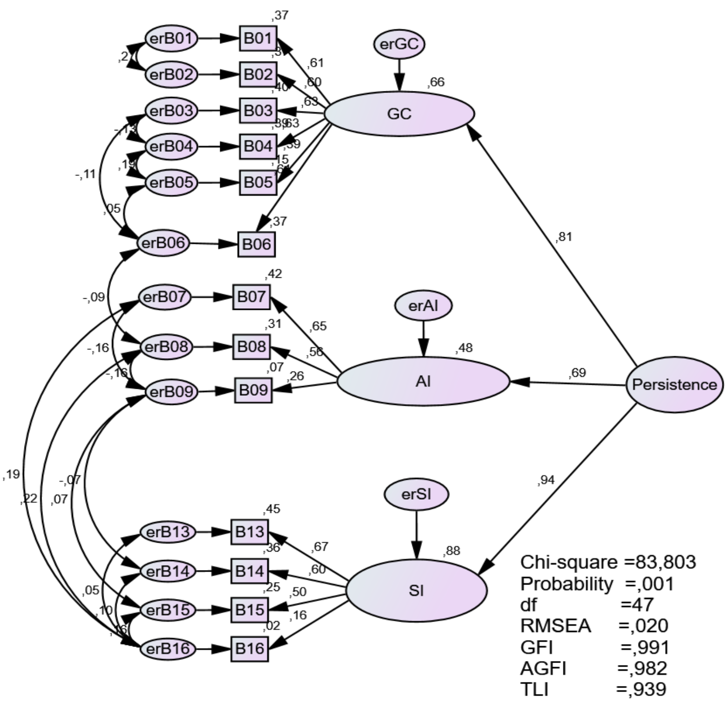

Figure 3: Measurement Model of Student Persistence Construct (Model C)

Development of persistence constructs measurement model of learning (Model C) shows the results already fit. It can be seen from across the statistical value of GFI, AGFI, TLI and RMSEA has reached the rule of the thumb that have been defined. The only statistical value still does not meet the cut off value is the chi-square $\chi^2 = 83.803$ and $p = 0.001$. The ideal value of chi-square statistic which ideally is the value of probability $p > 0.05$. The value of chi-square statistic was likely to be significant if the sample size is quite high. There are three weaknesses that must be noted about the statistical chi-square when it is used to test the hypothesis of goodness of fit of a model, namely: (1) The chi-square test is highly dependent on the fulfillment of some prerequisites (validity of the hypothesis, normal multivariate distribution, and sample size, which very hard to meet on empirical data), (2) to get the goodness of fit are both needed a model that was more complex model, and (3) if the sample size enlarges, chi-square value is expected to increase leading to the rejection of the model even though the value of the difference between S and Σ has a minimum [21, 25, 26, 27, 28].

After deciding to accept a measurement model construct by testing goodness of fit, then the next step is to look at the estimated value of the parameter lambda (standardized regression weights). From Table 3 and Table 4 seems that Model C generates the estimated value of the entire parameter lambda is already quite large and significant at the 1% level. Lambda coefficient value at a significant level of first order shows that these items reflect dimensions. Lambda coefficient values on items which reflect the dimensions of goal commitment (GC) and the dimension of social integration (SI) is relatively higher than the value of the coefficient lambda on items that reflect the dimension of academic integration (AI). This result meant that items that reflect the dimensions of goal commitment (GC) and the dimension of social integration (SI) are relatively stronger than the items that reflect the dimension of academic integration (AI).

Consistent with the results of the first-order level, at the level of second order analysis results estimated value of lambda parameters were large and significant at the 1% level. This indicates that the three dimensions: the dimension of goal commitment, dimension of academic integration and dimension of social integration reflect the construct of student learning persistence. Social integration is a significant dimension of the first and most powerful $(\lambda = 0.937)$ in the reflect construct of student persistence. Goal commitment is the second strongest dimensional $(\lambda = 0.810)$ in reflecting on student persistence construct, while academic integration is the strongest third dimension $(\lambda = 0.695)$ in reflecting on student persistence construct.

V. CONCLUSION

Construct of UT student persistence is reflected in three dimensions, namely social integration, goal commitment, and academic integration. Goal commitment dimention is reflected by the 6 items, dimension of academic integration is reflected by three items, and dimension of the social integration is reflected by the 4 items. The estimation results of the entire coefficient lambda test results are significant at the 1% level, both for the coefficient lambda in the first-order analysis and the second order analysis. The measurement model of UT student persistence construct has a value of goodness of fit statistics $\chi 2$=83.803; p=0.001; GFI=0.991; AGFI=0.982; TLI=0.939; and RMSEA=0.020.

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APPENDIX

INSTRUMEN KONSTRUK PERSISTENSI BELAJAR MAHASISWA

NO	PERNYATAAN	JAWABAN			
1	Belajar di UT dapat memenuhi harapan saya dalam menempuh pendidikan tinggi.	○ Tidak Yakin	○ Kurang yakin	○ Yakin	○ Sangat Yakin
2	Belajar di UT dapat meningkatkan pengetahuan saya.	○ Tidak yakin	○ Kurang yakin	○ Yakin	○ Sangat yakin
3	Saya tetap memilih UT, meskipun ada kesempatan untuk pindah belajar ke lembaga lain.	○ Tidak yakin	○ Kurang yakin	○ Yakin	○ Sangat yakin
4	Saya telah mengalokasikan waktu secara maksimal untuk kegiatan belajar di UT.	○ Tidak setuju	○ Kurang setuju	○ Setuju	○ Sangat setuju
5	Saya telah mengalokasikan dana yang cukup untuk kegiatan belajar di UT.	○ Tidak setuju	○ Kurang setuju	○ Setuju	○ Sangat setuju
6	Menyelesaikan pendidikan di UT merupakan hal yang penting bagi saya.	○ Tidak penting	○ Kurang penting	○ Penting	○ Sangat penting
7	Apabila dalam modul ada yang tidak jelas, saya berusaha bertanya kepada siapa saja yang saya anggap tahu.	○ Tidak pernah	○ Jarang	○ Sering	○ Selalu

NO	PERNYATAAN	JAWABAN			
8	Untuk memahami materi modul dengan baik, saya mencari sumber lietratur lainnya.	◯ Tidak pernah	◯ Jarang	◯ Sering	◯ Selalu
9	Saya mengikuti kegiatan tutorial tatap muka yang diselenggarakan oleh UT (rata-rata tiap mata kuliah) sebanyak:	◯ tidak pernah	◯ 1-3 pertemuan	◯ 4-6 Pertemuan	◯ 7-8 pertemuan
10	Saya mengikuti kegiatan tutorial *online* yang diselenggarakan oleh UT (rata-rata tiap mata kuliah) sebanyak:	◯ tidak pernah	◯ 1-3 inisiasi	◯ 4-6 inisiasi	◯ 7-8 inisiasi
11	Tugas tutorial tatap muka yang saya kerjakan dengan baik (rata-rata tiap mata kuliah) adalah:	◯ Tidak pernah	◯ 1 tugas	◯ 2 tugas	◯ 3 tugas
12	Tugas tutorial *online* yang saya kerjakan dengan baik (rata-rata tiap mata kuliah) adalah:	◯ Tidak pernah	◯ 1 tugas	◯ 2 tugas	◯ 3 tugas
13	Meskipun di UT dengan sistem belajar mandiri, saya tidak merasa ‘kesendirian’ atau ‘kesepian’.	◯ Tidak Setuju	◯ Kurang setuju	◯ Setuju	◯ Sangat setuju
14	Saya merasa kuliah di UT dapat meningkatkan status sosial di masyarakat.	◯ Tidak setuju	◯ Kurang setuju	◯ Setuju	◯ Sangat setuju
15	Saya berinteraksi dengan sesama mahasiswa UT.	◯ Tidak pernah	◯ Jarang	◯ Sering	◯ Selalu
16	Saya berinteraksi dengan mahasiswa perguruan tinggi lain (selain mahasiswa UT).	◯ Tidak pernah	◯ Jarang	◯ Sering	◯ Selalu

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Mathematical Algorithm on Conventional Computerized Adaptive Testing

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Abstract - In education, it is important to determine the ability of the students on a subject. By knowing it, a teacher can take appropriate action to deliver good education. One method to determine the ability of the student is by performing adaptive testing. Adaptive testing is a testing method in which each examinee will be given a different set of questions based on the ability of each student. Thus, each examinee do not need to answer all questions. The items were selected with specific procedures based on the estimated level of ability of the students which reflected on their responses. Adaptive testing can be automated using a computer device, called a computerized adaptive testing (CAT). The CAT based on item response theory (IRT) with one parameter logistic model, two parameters, and 3 parameters. CAT has many advantages compared to other testing applications and has been shown to have high efficiency and reliability. CAT is also very capable to be developed further, both in terms of procedure and also the application. Eventhough there has a lot of references about CAT and its development, but in reality it is not easy to build a CAT application program as a whole. In this paper, the authors will share the experience in developing a conventional CAT application in a detailed mathematical algorithms and examples of results analysis obtained by the response answers from the students. This paper is expected to provide an initial basis for other developers and CAT researchers to build, develop and further improvement of the CAT program for large-scale applications.

Keywords: *education, adaptive, testing*

I. INTRODUCTION

In principle, the test was built to meet the needs of the groups for the test with a view to estimating the level of ability of the test participants. Giving the test is too easy for the person taking the test is a waste of time. Usually cause unwanted behavior such as fault for not careful or perhaps deluded by the answer of a trick question. Instead, the questions are too difficult, also produces test scores are not informative. Participants may stop with serious tests to try to answer the question, choosing to guess, or respond to other undesirable behavior. Adjust the test to bring the level of ability of each individual participant tests, a solution should be sought. How to test participants than if each person taking the test is given a different test?

Adaptive testing is also referred to as tailored test, which is a test that adjusts the ability of participants. Hambleton said that the definition of a computerized adaptive testing "would be to give every examinee a test that is 'tailored' or adapted, to the examinee's ability level" [1]. The use of computers to be used in the test is adaptive used to be called Computerized Adaptive Testing (CAT). Known as the implementation of computerized testing really was no longer using "paper and pencil". Adaptive, because the grains have been selected based on the results because the self-regulatory analysis and adapted to the needs or abilities of the examinees, works automatically through a computer software. According Wainer, adaptive testing is a test which was held for the participants of the test with a grain because determined by the answer (response) test participants [2].

II. THEORY OF CONVENTIONAL CAT

In general, conventional CAT system has components, namely (1) item banks, and working systematic CAT comprising components (1) item selection procedure, (2) ability estimation, and (3) stopping rule [2].

A. Items Bank

CAT taking items from a question bank that is based on Item Response Theory (IRT) using models 1, 2, or 3 parameter logistic (1 PL, 2 PL, or 3 PL) having the parameters of grains, namely b (difficulty), a (discrimination), and c (pseudo-guessing). Question bank for the purpose of CAT should have those items with a power level is high and the distribution is uniform (rectangularly) at every level of ability [3] and should contain those items with: different power (a) has a distribution that is uniform between 0, 4 to 2.0, the index of difficulty (b) be spread uniformly between -3.0 to 3.0, and the factor guess apparent (pseudo guessing) (c) be spread between 0 to 0.3 [4] [5]. More specifically, Urry [6] suggest a question bank that is ideal for both CAT must have: the power parameter is different items (a) above 0.8, difficulty index parameter (b) has a wide distribution, and pseudo guessing factor parameter (c) of less than 0.3.

B. CAT systematics

Diagram adaptive test algorithms can be seen in the following figure:

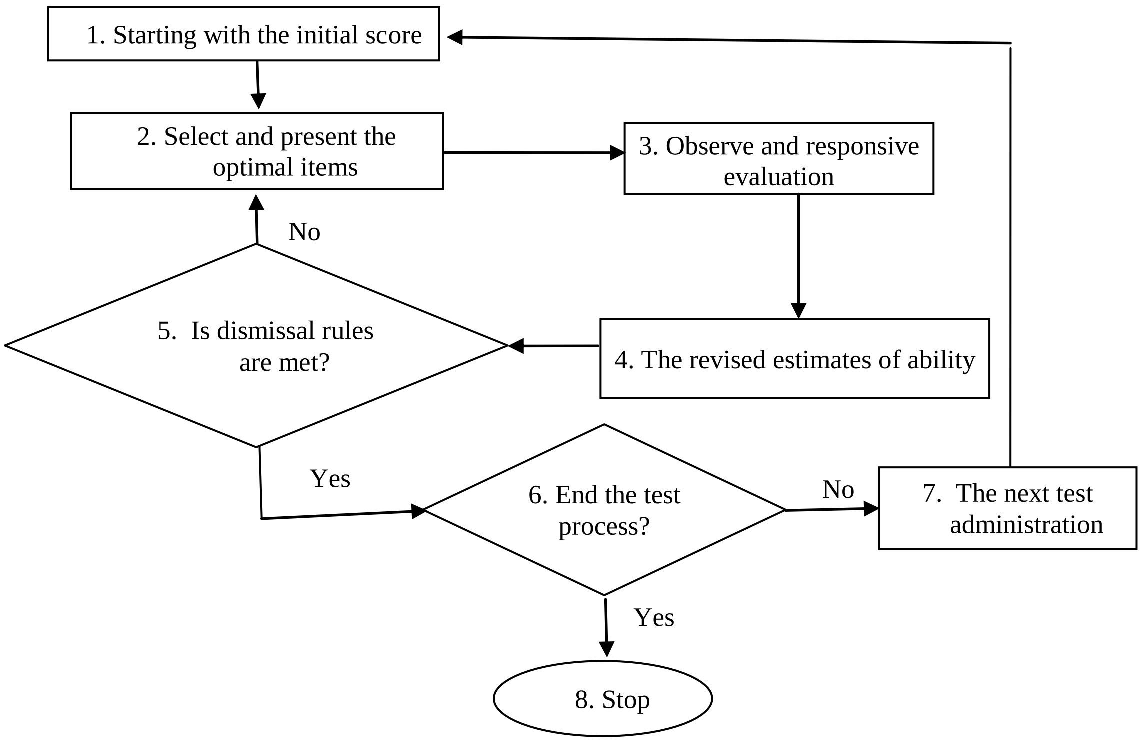

FIGURE 1. FLOW CHART ADAPTIVE TESTING

Based on the picture above, initially capabilities while participants estimated. Next awarded / presented items that optimally match the initial capability. Observe and evaluation of participants' responses. After the correct estimation of ability level of the participants. Then based on the rules of the dismissal of the test, to test whether the dismissal of the test criteria have been met or not. If you have met the test stops, otherwise if not met the participants are given optimal other items. This continues until the fulfillment of the criteria for dismissal of tests.

Systematics CAT contains the rules outlined in the steps that must be followed when participants carry out the test. The measures are commonly used to develop conventional CAT algorithm as follows [7]:

1. *How to Get Started* : The first items was given on the test taker?
2. *How to Continue*: After no response, the following items will be given to how the test taker?

3. *How to End*: When will the test be stopped?

Three main steps systematics CAT program, ie start, continue, and end, explained in more detail in the following sections:

1. CAT Starting Point

When CAT starts, no items were given to the participants of the test, there has been no response (response) given by the participants so that the test participants' ability levels can not be estimated. If no preliminary information about the ability of test takers, the CAT can begin by selecting the items beginning with a moderate level of difficulty [8] [9]. By selecting the items beginning with a medium level of difficulty, the participants answered any further tests that will be given items easily. Conversely, if answered correctly will be given items difficult.

Technically, it should be given a time limit for the test participants to respond to the answers. This is because the system will continue to wait for a response CAT test takers when there is no time restriction. Although given the limitations of time, Wise advise given sufficient time limit taking into account the factor of anxiety in the test participants take tests [10].

2. Continuing Process

After obtaining the response of the participants' answers to the test items given, CAT system gives a response assessment with a right or wrong answer. CAT system will decide whether or not to continue the test. There are two steps to continue the process of estimating the level of ability that CAT takers and how to choose the next items.

a. Methods of Estimating Capabilities

Having answered the item first given, the ability of the test taker is estimated based on the parameters of items, the estimated value of the initial capabilities, and answers to the items whether true or false. The general method used to estimate the ability of the test taker is Maximum Likeli-hood Estimation (MLE) [11] [12].

Suppose a test participants with ability θ answered tests containing n item multiple-choice items with unknown parameters (previously estimated). Joint opportunities of test participants can be written as $P(U_1,U_2,\ldots,U_n \mid \theta)$. In practice, $U_1,U_2,\ldots,U_n$ replaced with a score of items to participants who actually written as $u_1,u_2,\ldots,u_n$ (u_i = 0 If the answer on items to i wrong, and u_i = 1 If the answer on items to i correct). Furthermore, if the assumption of local independence is applied then the likelihood function; $L(\theta)$, written as follows :

$$L(\theta) = P(U_1 = u_1, U_2 = u_2, \ldots, U_n = u_n \mid \theta) = \prod_{i=n}^{n} P_i(\theta)^{u_i}\, Q_i(\theta)^{1-u_i}, \qquad (1)$$

with $i = 1, 2, \ldots, n, -\infty < \theta < \infty$.

The objective of MEE is finding value maximization $L(\theta)$. The parameter values that maximize the likelihood function capability, L, referred to *the maximum likelihood estimate of ability*. Mathematically, it is the same as to find a value that maximizes the value of the natural logarithm, *ln* $L(\theta)$. The core value can be obtained by making the first derivative of *ln* $L(\theta)$ toward θ equal to zero.

$$\frac{\partial \ln L(\theta)}{\partial \theta} = \sum_{i=1}^{n} [u_i - P_i(\theta)]\, \frac{P_i'(Q)}{P_i(\theta)\, Q_i(\theta)} = 0 \qquad (2)$$

In practice, to solve systems of equations above is done by using the Newton-Raphson iterative procedure. Score θ in iteration ($m + 1$) can be expressed using recurrent relations. The iteration process stops when $error < \varepsilon$, with ε very small numbers. In this study used value ε = 0.0001.

One problem with the application of MLE method on adaptive testing is the inability of the likelihood function to find a solution when there is a maximum of examinees who earn a score of 0 (answered wrong on all items) or a perfect score (answered correctly on all items), except examinees who earn scores were excluded from the estimation process. Examinees who obtain a score of 0 would acquire θ = -∞ (due to u_i = 0 only be met by θ = -∞), and a perfect score would be obtained θ = +∞ (due to u_i = 0 only be met by θ = +∞). Both of these scores are difficult to interpret in the application.

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To overcome the problem of the inability of MLE method in estimating the level of response capability when the participants have not figured test participants can use the method *step size* [13] [14]. Based on the method step size, ability level test participants increased or decreased by a certain number of participants during the test have not been patterned response. Suppose CAT using a step size of 0.5 and a degree of prior knowledge of participants test setup value 0. This means that when one participant answered correctly all the tests on the first three items given, the estimated level of ability of (0 + 0.5 + 0.5 + 0.5) = 1.5. Conversely, if the participant answered incorrectly are all on the first three items, the estimation of his ability level (0-0.5-0.5-0.5) = -1.5.

b. Selection of next items

Once the ability of participants is estimated, the next computer select the next items. Lord suggests using items maximum information procedure to select the next items to be given to the participants of the test [15]. Based on this procedure, item that has a value function greatest information on the ability of certain participants have to be given to the test taker. This ensures that the value of the function test information for each person taking the test is maximum, meaning that the standard error of measurement (SEM) minimum because no other test information function is the inverse of the variance of the measurement error. In other words, this method guarantees will yield prediction skill level of participants with high accuracy [16].

Value item information function (IF) illustrates how accurate some items can estimate the ability of the test taker. Using the information function, the accuracy of measurement in estimating the ability of test takers can be calculated at every level of ability. Function Birnbaun information item to be stated by the following equation [1]:

$$I(\theta) = \frac{2.89\, a_i^2\, (1-c_i)}{\left[\left(c_i + exp\left(1{,}7\, a_i(\theta - b_i)\right)\right)\right]\left[1 + exp\left(-1{,}7\, a_i(\theta - b_i)\right)\right]^2} \tag{3}$$

The above equation shows that the information is only dependent on grain parameter (eg a, b, and c for the model 3P) and the level of ability (θ). Thus for every level of ability (θ), the contribution of the function information for each item in the question bank can be calculated.

Function test information is the number of item information function test developers such [17]. Information function test device is mathematically written as follows:

$$TIF = \sum_{i=1}^{n} I_i \tag{4}$$

As a function information item, the information function tests illustrate how accurate the estimate test different ability levels. The greater level of information on given ability, the more accurate the estimated ability of the test device.

Standard error of measurement (SEM) is expressed by the following equation [1]:

$$SEM = {}^{1}\!/_{\sqrt{TIF}} \tag{5}$$

c. Stopping Rule

Two main methods are used to stopping CAT, equal measurement precision and fixed number item. Both of these methods produce different measurement error variance. Is the purpose of the method equal measurement precision is generating test scores with the same error rate measurements for each test taker's ability. But the predicted length of the test varies from one participant to the other test participants. Standard error of measurement equivalent capped at 0.03 with a reliability of 91% on conventional tests [18]. But in practice it is used also use criteria fixed number of items the dismissal rules CAT, eg using criteria fixed starting rule as much as 20 grains to avoid the process of tests that may not converge.

Selection criteria assumptions on the components of the CAT will have different consequences. With reference to some research results CAT was developed, then the assumption that the criterion selected in the CAT algorithm is as follows:

1) Selection of initial grain based on the level of difficulty was.
2) Estimation of the level of capability by using Maximum Likelihood Estimation (MLE).
3) Selection of the next item using the procedure maximum value of the function information item.
4) Rules dismissal of tests using *equal measurement precision* and *fixed number of item*.

III. CAT PROGRAM ALGORITHM

Conventional CAT algorithm is expressed as follows :

A. Starting CAT
- *Starting with the login process CAT program, including entering username, password, name, identity number, and others*

B. Selection of the first item that appears.
- *Select the first item with the medium level of difficulty by randomly ie* $-0.5 \leq b \leq 0.5$

C. Selection of the second item that appears
- *Because there is no pattern then it using step-size (assumed to be step-size using a value of 0.5). If the response is correct answer, select the item with a value of* $\theta = 0.5$ *and if the response is incorrect answers, select the item with a value of* $\theta = -0.5$
- *Calculate the information function I (θ) to (3), namely:*

  $$I(\theta) = \frac{2.89\, a_i^2\, (1-c_i)}{\left[\left(c_i + exp(1{,}7\, a_i(\theta - b_i))\right)\right]\left[1 + exp(-1{,}7\, a_i(\theta - b_i))\right]^2}$$

  with value :
  b = difficulty parameter
  a = discrimination parameter
  c = pseudo-guessing parameter
- *Calculate and find value I (θ) the maximum on all items, display items that have a value I (θ) the maximum.*

D. Selection of third item and the rest items
- *If the response to the second answer and so have not been patterned (always right or always wrong) then using the step-size with a value of θ added if the response answers +0.5 and -0.5 if the response is correct wrong answers.*
- *If the response answers the third and so have figured it using MLE*
  - *Calculate the estimated ability (ability level) test participants (θ) with the Newton-Raphson iterative procedure.*

    $$\theta_{duga} = \theta_{duga\,0} + error \qquad (6)$$

    where

    $$error = \frac{\sum 1.7\, a\, (u-P)\, (P-c)/\left(P\, (1-c)\right)}{\sum\, [-1.7^2\, a^2\, ((1-P)/P)]\, [(P-c)/(1-c)]^2} \qquad (7)$$

    with value :
    u = 1 if the student answers correctly
    u = 0 if the student answers wrong
    P = participants the opportunity to answer item correctly by the formula

    $$P = c + \frac{(1-c)}{\left(1 + exp\left(-1.7\, a\left(\theta_{duga\,0} - b\right)\right)\right)} \qquad (8)$$
  - *Iterating until got error ≤ 0.0001, then θ_duga = θ, iteration will take place at convergent and fast, usually iterations already completed less than 10 cycles.*
  - *Calculate the information function I (θ) with the above formula, find the value of I (θ) maximum on all items, display items that have a value I (θ) the maximum.*
  - *Calculate Test Information Function with (4), namely :*

    $$TIF = \sum_{i=1}^{n} I_i.$$

    by Ii = Item Information Function (IF)
  - *Calculate SEM (5) ie :*

    $$SEM = {}^{1}\!/_{\sqrt{TIF}}$$

E. Rules dismissal of tests using equal precision measurement and a fixed number of items..
- Rules discharge test with equal precision measurement
  - *The test will be stopped when the SEM ≤ 0.3, get the latest θ*
- Rules discharge test with a fixed number of items.
  - *The test will be stopped when the item appears achieve maximum number (eg 20 items), get last θ*

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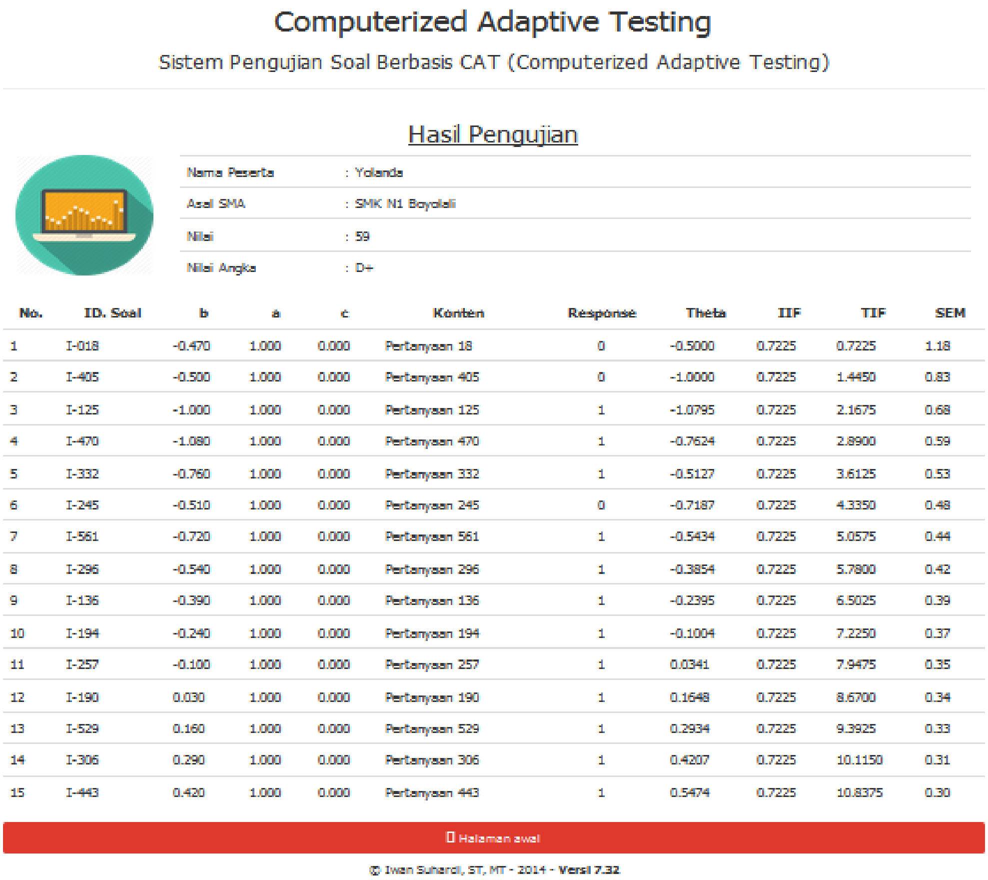
- *If the item is not patterned, always answer true or always answered incorrectly, the test will stop when $\theta \geq 3$ or $\theta \leq -3$*
- *Give limitation rule with :*
  When obtained $\theta \geq 3$, then $\theta = 3$, and if obtained $\theta \leq -3$, then $\theta = -3$

- Conversion value obtained by the formula

$$Score = 50 + \left(\frac{50}{3}\,\theta\right) \tag{9}$$



Computerized Adaptive Testing

Sistem Pengujian Soal Berbasis CAT (Computerized Adaptive Testing)

Hasil Pengujian

Nama Peserta	: Yolanda
Asal SMA	: SMK N1 Boyolali
Nilai	: 59
Nilai Angka	: D+

No.	ID. Soal	b	a	c	Konten	Response	Theta	IIF	TIF	SEM
1	I-018	-0.470	1.000	0.000	Pertanyaan 18	0	-0.5000	0.7225	0.7225	1.18
2	I-405	-0.500	1.000	0.000	Pertanyaan 405	0	-1.0000	0.7225	1.4450	0.83
3	I-125	-1.000	1.000	0.000	Pertanyaan 125	1	-1.0795	0.7225	2.1675	0.68
4	I-470	-1.080	1.000	0.000	Pertanyaan 470	1	-0.7624	0.7225	2.8900	0.59
5	I-332	-0.760	1.000	0.000	Pertanyaan 332	1	-0.5127	0.7225	3.6125	0.53
6	I-245	-0.510	1.000	0.000	Pertanyaan 245	0	-0.7187	0.7225	4.3350	0.48
7	I-561	-0.720	1.000	0.000	Pertanyaan 561	1	-0.5434	0.7225	5.0575	0.44
8	I-296	-0.540	1.000	0.000	Pertanyaan 296	1	-0.3854	0.7225	5.7800	0.42
9	I-136	-0.390	1.000	0.000	Pertanyaan 136	1	-0.2395	0.7225	6.5025	0.39
10	I-194	-0.240	1.000	0.000	Pertanyaan 194	1	-0.1004	0.7225	7.2250	0.37
11	I-257	-0.100	1.000	0.000	Pertanyaan 257	1	0.0341	0.7225	7.9475	0.35
12	I-190	0.030	1.000	0.000	Pertanyaan 190	1	0.1648	0.7225	8.6700	0.34
13	I-529	0.160	1.000	0.000	Pertanyaan 529	1	0.2934	0.7225	9.3925	0.33
14	I-306	0.290	1.000	0.000	Pertanyaan 306	1	0.4207	0.7225	10.1150	0.31
15	I-443	0.420	1.000	0.000	Pertanyaan 443	1	0.5474	0.7225	10.8375	0.30

Halaman awal

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FIGURE 2. SAMPLE RESULTS OBTAINED CAT

TABLE 1. DESCRIPTION OUTPUT CAT

<table>
<tr><th>No.</th><th>Item ID.</th><th>b</th><th>a</th><th>c</th><th>Content</th><th>Response</th><th>Theta</th><th>IIF</th><th>TIF</th><th>SEM</th></tr>
<tr><td>1</td><td>I-018</td><td>-0.470</td><td>1.000</td><td>0.000</td><td>Question 18</td><td>0</td><td>-0.5000</td><td>0.7225</td><td>0.7225</td><td>1.18</td></tr>
<tr><td colspan="2">Information:</td><td colspan="9">The first point is drawn at random by selecting the item with a difficulty level was -0.5 ≤ b ≤ 0.5. Student answered incorrectly, then the step-size models will appear θ = - 0.5. The IIF calculated values for θ = -0.5 obtained in a matter of numbers with Item ID. I-405 as the second items. Because the student answers incorrectly, the following items appear easier.</td></tr>
<tr><td>2</td><td>I-405</td><td>-0.500</td><td>1.000</td><td>0.000</td><td>Question 405</td><td>0</td><td>-1.0000</td><td>0.7225</td><td>1.4450</td><td>0.83</td></tr>
<tr><td colspan="2">Information :</td><td colspan="9">For items the student answers incorrectly, it still uses the step-size models because they still have not figured in order to extract the value of θ = (-0.5) + (-0.5) = -1. The IIF calculated values for θ = - 1 obtained in a matter of numbers with Item ID. I-125 as the third items. Because the student answers incorrectly, the following items appear easier.</td></tr>
<tr><td>3</td><td>I-125</td><td>-1.000</td><td>1.000</td><td>0.000</td><td>Question 125</td><td>1</td><td>-1.0795</td><td>0.7225</td><td>2.1675</td><td>0.68</td></tr>
<tr><td colspan="2">Information :</td><td colspan="9">For items three students answered correctly, the next is already used models MLE for the order item has been patterned, so that by way of iterating obtained value θ = -1.0795. The IIF calculated values for θ = - 1.0795 obtained in a matter of numbers with Item ID. I-470 as a fourth items.</td></tr>
<tr><td>4</td><td>I-470</td><td>-1.080</td><td>1.000</td><td>0.000</td><td>Question 470</td><td>1</td><td>-0.7624</td><td>0.7225</td><td>2.8900</td><td>0.59</td></tr>
<tr><td colspan="2">Information</td><td colspan="9">Although the student answers correctly, the fourth item that appears to have slightly lower levels of difficulty, than ever before. It is ideal not supposed to happen. Supposedly items appear to be more difficult than the previous items. This could happen because there is a question bank that has a difficulty level parameters uneven.</td></tr>
<tr><td>5</td><td>I-332</td><td>-0.760</td><td>1.000</td><td>0.000</td><td>Question 332</td><td>1</td><td>-0.5127</td><td>0.7225</td><td>3.6125</td><td>0.53</td></tr>
<tr><td colspan="2">Information</td><td colspan="9">For items five students answered correctly, then the model is used MLE sought IIF maximum value to</td></tr>
</table>

		get items that will appear. Because the students answered correctly, the next items that appears more difficult. And so on.								
6	I-245	-0.510	1.000	0.000	Question 245	0	-0.7187	0.7225	4.3350	0.48
7	I-561	-0.720	1.000	0.000	Question 561	1	-0.5434	0.7225	5.0575	0.44
8	I-296	-0.540	1.000	0.000	Question 296	1	-0.3854	0.7225	5.7800	0.42
9	I-136	-0.390	1.000	0.000	Question 136	1	-0.2395	0.7225	6.5025	0.39
10	I-194	-0.240	1.000	0.000	Question 194	1	-0.1004	0.7225	7.2250	0.37
11	I-257	-0.100	1.000	0.000	Question 257	1	0.0341	0.7225	7.9475	0.35
12	I-190	0.030	1.000	0.000	Question 190	1	0.1648	0.7225	8.6700	0.34
13	I-529	0.160	1.000	0.000	Question 529	1	0.2934	0.7225	9.3925	0.33
14	I-306	0.290	1.000	0.000	Question 306	1	0.4207	0.7225	10.1150	0.31
15	I-443	0.420	1.000	0.000	Question 443	1	0.5474	0.7225	10.8375	0.30
Information		CAT will stop because the value of SEM meets the criteria, namely the dismissal of ≤ 0.3. Last θ value obtained by the 0.5474 conversion into the final value, a score 59								

IV. CONCLUSIONS AND RECOMMENDATIONS

A. *Conclusions*

In education, it is important to determine the ability of students in a subject. Adaptive testing is a testing method in which each examinee will be given a set of different questions adjusted according to the ability of each learner. Thus, each of the examinees do not need to answer all the problems that exist. CAT has many advantages compared to other testing applications such as paper and pencil test or CBT, and has been proven to have high efficiency and reliability. Participants ability test already can be estimated only by answering less than half of the items required in a paper and pencil test or CBT. In building a conventional CAT application basically covers started CAT (starting point), the process continues CAT (continue process) and CAT dismissal rules (stopping rule). CAT also be supported by IRT-based question bank and evenly distributed so that students can have the ability to estimate optimal accuracy.

B. *Recommendations*

Paper is expected to be able to provide a foundation early in the morning of developers and researchers to build and develop the CAT program for wider scale applications. Conventional CAT designs have the possibility of items given to participants of the test does not represent all of the modules / materials that exist. Development suggested among others by constraint content so that all modules / material can appear in a matter of CAT. Among other development control procedures and equity items appear (item exposure), and CAT integrate with other e-learning modules to determine which modules need to be studied further.

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The Development of Students Worksheet Using GeoGebra Assisted Problem-Based Learning and Its Effect on Ability of Mathematical Discovery of Junior High Students

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Abstract-Mathematical discovery have contributed to human life. There are many applications of mathematical discovery in economics, social, culture, and information technology and computer. To create students which have ability to discover mathematic needed an appropriate learning approach. One of the alternatif approaches which can be used is to combine between GeoGebra and Problem-Based Learning (PBL). This study aims to get a worksheet which combining between GeoGebra and PBL, to get good quality of students' worksheet, and to analyze its impact on students' ability of mathematical discovery. This study was a research and development study conducted in MTs Negeri Kota Ternate, North Maluku. The data collect were those on the quality of the developed worksheet and students' ability of mathematical discovery collected through evaluation form and a test. The data were analyzed using SPSS. Based on the study, the following conclusion can be drawn. (1) The quality of students' worksheet can be categorized in good criteria, (2) There is an effect of developed students' worksheet on students' ability of mathematical discovery, and (3) Students' ability of mathematical discovery taught by developed worksheet is higher than those taught by traditional approach.

Keywords: *geogebra, mathematical discovery, problem-based learning*

I. INTRODUCTION

Mathematics is a science that has many roles in the development of individuals and society [1]. Mathematics is needed to help intellectual development. As an example, problem-solving activities in mathematics whish assist students in the development of thinking. In the development of society, the role of mathematics can be seen in various fields, for example in education and development of science and technology. As a tool in support of science and technology, mathematics should be developed and be applied in everyday life in a variety of tools and technologies. Therefore, the world waits for more discoveries in mathematics as an effort to improve the life of mankind. Surely the role of a mathematician is needed in the new invention because a growing number of mathematicians, the more new discoveries.

One way to increase a lot of mathematicians is to cultivate and educate prospective mathematicians in the school. Therefore, teachers need to enhance them role in creating new inventors in mathematics. However, at this time most math teachers only produce students or graduates who have little mathematical skills and do not have the knowledge or experience in the discovery of mathematical [2]. In addition, although some mathematics textbooks featuring a conjecture in the presentation of the material but learning activities in schools today is felt its characteristics. It is apparent from the reduced mathematical algorithm presented by the teacher in explaining the material; students do not learn why it requires mathematical conjectures and concepts; they rarely discover why definitions, examples, theorems, and the evidence is very important or interesting; and students think that learning mathematics is just learning about the rules and rigid measures [3].

Each student would not have to be a mathematician or good at mathematics. But students need to master mathematics early in the technological development. Therefore, equip learners with the ability of mathematical discovery is needed, so that learners can have the ability to find patterns that occur in real life is always changing, uncertain and competitive. By finding patterns that occur in everyday life, students are expected to predict and solve a problem that will be and are being faced.

Mathematical discoveries in the classroom are only possible at an appropriate learning environment. The use of multi-strategy approach and the use of technology can be used as a tool in mathematical discovery. However, it has become common that the learning strategies used by teachers not changed much until now. Mathematics teachers still use traditional learning in the classroom. Where, learning activities centered on the teacher as a source of information. Teachers spoke at the beginning of the lesson, explaining material and sample questions and presents exercises that should be done by students. Most mathematics teachers rarely or never taught with technology so that the integration of technology in learning mathematics progressing very slowly. In addition, some teachers actually have access using a computer and suitable software both at school and at home, however, the technology and the facilities there are rarely integrated by teachers in teaching on a regular learning [4].

Characteristics of learning activities that allow generates an discovery is a learning activity in which there are activities that allow students to be able to make observations. Of course, these observations based on a task/activity and problems that allow the students to acquire a variety of results, make mistakes, make improvements, and summed up the results that have been obtained. One alternative approach to learning that has these characteristics is a problem-based learning (PBL). It is possible because of the discovery of several mathematical discoveries that is the solution of a problem or activity.
In addition to PBL, technology (computers) can also be used as a tool in mathematical discovery activities [5]. Technology has affected the world of education today. That is because the availability of various hardware and software and the means or information and communications technology (ICT) that can be used by students to learn. ICT least affect subjects in school, knowledge, curriculum, how the work of experts, the way teachers teach, how students work either individually or in groups, and the way students learn. That influence has consequences for the competence of teachers and has implications for teacher. Teachers should also be able to use these technologies both in the classroom and the laboratory [6].

The availability of technology (computers) and various software whether paid or free should not make an excuse for teachers not to use such software in learning. There are at least three groups of software commonly used in mathematics. There is a dynamic geometry software or dynamic geometry software (DGS), the computer algebra systems (CAS) and spreadsheets [7]. However, software that is widely used in mathematics only two, namely the dynamic geometry software and computer algebra system [8].

Development of technology today has encouraged software developers to try to combine multiple types of software into single software, one of which is GeoGebra. GeoGebra is dynamic mathematics software for all levels of education that combine arithmetic, geometry, algebra, and calculus [9]. GeoGebra can be used in learning-oriented activity and problems [10]. GeoGebra developers expect that with this software mathematics will be easily understood. He also wanted to show to students that mathematics is very useful and interesting. With GeoGebra students can play with mathematics. They can do quickly, drag the point wherever they want, can experiment with mathematics, and make a better understanding in the students [11]. Therefore, introducing GeoGebra is the right way to improve the quality of learning and is expected to improve student learning achievement [12]. With GeoGebra, students can see the abstract concepts, make connections, and discover mathematics [9] and reduce calculation errors when compared with calculations by hand [13]. GeoGebra provide flexibility to students to investigate deeper into a geometric shape. They can express various things that may not be found or do when they use paper and pencil in constructing geometric objects [14]. Additionally, GeoGebra can give students the opportunity to conduct an investigation, observation theorem, and make conjecture [15].

PBL provides more effective effect in the study of mathematics as compared with the traditional learning in improving the understanding and use of mathematical concepts of students in real life [16]. In addition, technology is important in the learning of mathematics [17]. However, integrating GeoGebra in learning activities with the PBL approach is not easy [18]. Fewer training materials about PBL [19] and the availability of computer labs are not enough to guarantee the implementation of the use of computers in the classroom on regular learning activities [20]. Therefore, the development of materials or instructional materials that integrate technology into PBL through the development of this research is essential to solve the challenges or problems that occur in learning. Specifically, this study also addresses the challenges of the slow progress in the integration of technology in learning mathematics [4]. This research is also expected to solve the difficulties students understand the material presented teachers, motivate teachers to be able to share his knowledge to students, and helping to organize knowledge so that students learn better when study with PBL [21].

II. METHOD

This study is a Research & Development (R & D). Educational Research and Development is an industry-based development models in the which the finding of research are used to design new products and procedures, the which then are systematically field-tested, evaluated, and refined until they meet specified criteria of effectiveness, quality, or similar standards [22]. Educational research and development (R & D) is a process used to develop and validate educational products [23]. The major purpose of R & D Efforts is not to formulate or test theory but to develop effective for use in schools [24]. Products of the research and development of teaching materials may include teacher training, teaching materials, instruments related to psychology, teaching materials in the form of media, and management systems. There are two things that must be considered by researchers in the development of a prototype product of research and development. First, if researchers make their own prototype model, the researchers will make themselves as the applicable procedures. Second, if the researchers chose to make modifications to the products available, the researchers simply adjust some aspects or working procedures in accordance with the circumstances of the desired [25].

The research model in this study is a model of research and development in the field of education that aims not to formulate or test the theory but aims to produce learning materials in the form of teaching materials that include lesson plans and worksheets. In addition, this study aims to develop a prototype of its own, which means that the prototype model developed will be made based on the applicable procedures. The procedure of research development in this research is the combining and adjusting the model or procedure based on some procedure of research and development. The procedures of the study include research and information collecting, planning, develop preliminary form of product, screening, expert appraisal, and try-outs.

The main purpose of research and development is not for the formulation and testing theories but to develop teaching materials to be used in schools [24]. To get quality teaching materials, the instructional materials will be developed through a process or stages of curriculum development. The first step taken is to perform the analysis on the initial activity, then performed a formative evaluation repeatedly aimed at improving the quality of products that have not been finished and continued with summative evaluation at the end of a process that aims to assess the effectiveness of the final product.

Formative evaluation aims to improve product quality and summative evaluation aims to determine effect and effectiveness of the product [26]. Formative Evaluation of the study include *screening and expert appraisal and summative evaluation is done through try-outs (the trial).* Product research in the form of lesson plan (LP) were evaluated by experts *(expert appraisal)* to see the extent to which the LP completeness or suitability of the material being taught. LP components are assessed include the completeness of the identity of the subjects; suitability indicators with; conformity with the purpose of learning competencies; the suitability of teaching materials to the learning objectives; the suitability of teaching methods to the learning objectives; featuring activities introduction, core, and cover with clear; suitability of learning resources with standards of competence; and conformity assessment with indicator of achievement.

Each expert gives a score of 1 if the components in each of the LP incomplete, giving a score of 2, if the components are rated less complete, and gave a score of 3, if it is complete. Furthermore, the average score of each expert summed to obtain an average, which are used as an assessment of each LP. LP quality criteria can be determined based on the following table.

TABLE 1. QUALITY CRITERIA OF LESSON PLAN

Average Score (X)	**Criteria**
X ≥ 2.33	Complete
1.67 ≤ X <2.33	Less Complete
X <1.67	Incomplete

Students worksheets (SW) evaluate based on some components that will be used as a reference to determine the quality of SW developed. Component SW assessed based on four main components which include the feasibility of the content, language, presentation, and graph. SW experts assess the value of 1 if the component is not very good, value 2 if the component SW is less appropriate, value 3 if the component SW enough, value 4 if the component SW good, and value 5 if the component SW very good. The average value of all experts will be used as a reference for determining the quality of SW. SW quality assessment in question can be seen in the following table.

TABLE 2. QUALITY CRITERIA OF STUDENTS WORKSHEET

The average score (X)	**Criteria**
4.01 <X	Very Good
3.34 <x ≤ 4.01	Good
2.67 <x ≤ 3.34	Enough
2.00 <x ≤ 2.67	Not Good
X ≤ 2.00	Very Not Good

After the *expert appraisal* is completed, the next step is doing summative evaluation of the products developed by experiments, by comparing the results of the development of products with other products. The experimental design which used in this study with is a quasi-experimental design. Type of quasi-experimental design used is *posttest design.* Researchers chose this kind of design because of its simplicity [27]. Subject of try out this study were students of class VII MTs Kota Ternate (Grade 7 of Junior High School). Subjects of try out the summative evaluation stage are class VII6 and class VII7. Class VII6 used as experimental class and class VII7 used as a control class.

The main instruments of this study are test of mathematical prior knowledge and test of mathematical discovery. Mathematical prior knowledge test is a test used to measure students' understanding of the material of the material that has been learned and predicted a support material in the material master triangle and quadrilateral. Test of mathematical discovery will be used to determine the ability of mathematical discoveries of students in finding relationships or properties in mathematics that can be done by generating a conjecture or theorems, identify deficiencies or simplification of evidence, and product a new method which one example is the strategy of new proof. The instrument measures the student's ability to generate conclusions about relationship midpoints of the sides of a rectangle and a wake formed by the midpoints; generate conclusions about the properties of the line formed by the relationship between the diagonal lines, median, and a line parallel to the side of the trapezoid; generate conclusions about the relationship between the properties of diagonal lines and the area is divided by a diagonal in the parallelogram; and generate conclusions about relationship angles in triangles and lines for the triangle. Both of these instruments have been tested base on the stages of the test items.

Data of quality teaching materials developed analyzed by deskriptif statistics and data of ability of mathematical will be analyzed using SPSS *(Statistical Product and Service Solution).* Data will be detected their *outliers* and data will be tested their assumptions of normality and homogeneity of variance. *Outliers* detected using z scores. Datum which has z scores around the absolute value of the 3 suspect as *outliers.* Therefore, the data are normally distributed approximately 99% should lie within 3 standard deviations from the average [28]. Therefore, the data that had z scores around three will be specifically noted. The assumption of normality is a requirement mostly inferential statistical procedures.

SPSS provides two formulas normality test, which Lilliefors normality test (Kolmogorov-Smirnov) and Shapiro-Wilk normality *test.* Theoretically, the normal curve has become a useful mathematical model for the statistics, because the connection with the central limit theorem [29]. A variable is said to be normally distributed or have a normal distribution if the distribution has the shape of a normal curve [30]. The research data also requires the assumption of normality because characteristics education research data which correspond to the normal curve. Test of homogeneity of variance using Levene test. This test is mostly used in parametric statistical tests. Moreover, the assumption of homogeneity of variance was also one of the assumptions that must be done in nonparametric statistical tests [31]. However, this assumption is not commonly used in nonparametric statistical test [32]. Therefore, if the normality assumption is not met, then the homogeneity test was not carried out further. If the assumptions of normality and homogeneity are met, the research hypothesis will be tested by paired t test. If the normality assumption is not met, then the first research hypothesis will be tested with the Mann-Whitney test.

III. RESULTS AND DISCUSSION

A. Quality of Instructional Materials

Teaching materials used in this study include Lesson Plan (LP) and the Student Worksheet (SW). The material studied in this research is based on Curriculum 2006. Curriculum materials include Triangle and Quadrilateral. In this study the material organized into ten lesson plan that includes a discussion of the properties of the Triangle; The properties of the Rectangle and Square; The properties Trapezoid and parallelogram; The properties of a Rhombus and Kite, Area of Rectangle and Square; Area of parallelogram and Trapezoid; Area of a Triangle and Rhombus; Area of Kites; Constructing Triangle and the Lines in the Triangle.

Before being used in research, LP were evaluated by experts to see how far the completeness or suitability of the LP with the material being taught. Experts who evaluated the LP are three experts. Data of expert analysis on the quality of LP showed that only 1 LP which shows the average value of 2.96. Besides LP 1, the average value of score of quality for other LP is 3.00. Therefore, based on assessment of the three experts pointed out that the lesson plan can be categorized into criteria are complete. The experts also stated that all LP can be used without revision. Student Worksheets (SW) this study are ten. The SW is named from SW-1 up to SW-10. Based on the average score of each SW of the three experts, it can be pointed out that all worksheets can be categorized into criteria Very Good. Overall experts also stated that the worksheets are created can be used without revision.

B. Data of Try-out

Teaching materials have been assessed by experts then tested. Test of teaching materials conducted in MTs (427) Kota Ternate. Sample classes used as the try out phase are Class of VII6 and VII7. Class of VII6 used as an experimental while Class of VII7 used as the control. Before learning activities both classes are tested to determine the prior knowledge of students. By removing some data suspected as outlier, it was concluded that the both of class eligible to be used as a sample class in this research. The findings obtained during the course of the trial as a reference for the improvement of teaching materials.

LP and SW trials do not face significant obstacles. However, there are few constraints, especially related to students' skills using a ruler, protractor, and the period during learning in the classroom. Several obstacles that include less-skilled students to use a ruler, some of them calculate the length of the sides did not start with the number 0 but 1, most of them are not able to use a protractor correctly. In addition, the selection of the arc that supports the learning activities must also be noted. As the following examples arc presented images that researchers recommended and not recommended in the selection of a protractor.

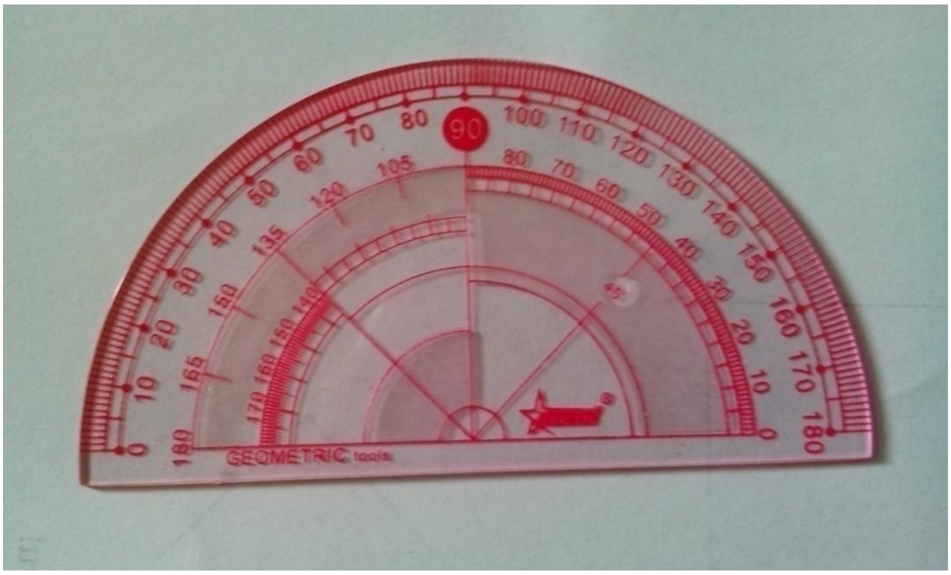

FIGURE 1. RECOMMENDED PROTRACTOR IN TEACHING AND LEARNING

FIGURE 2. PROTRACTOR WHICH NOT RECOMMENDED IN TEACHING AND LEARNING

As an example of the difficulty of students using a protractor was showed in Figure 3.2. The difficulty of students found in research activities was when the students calculate the angle of 70 $^{\circ}$. Pictures were a little small to be enclosed pictures of bees. It was causing students facing difficulty calculating the angle. To resolve this problem, the researchers took the initiative so that students are using tools, for example, students can use the paper when using the protractor like this. For example it showed in Figure 3.3.

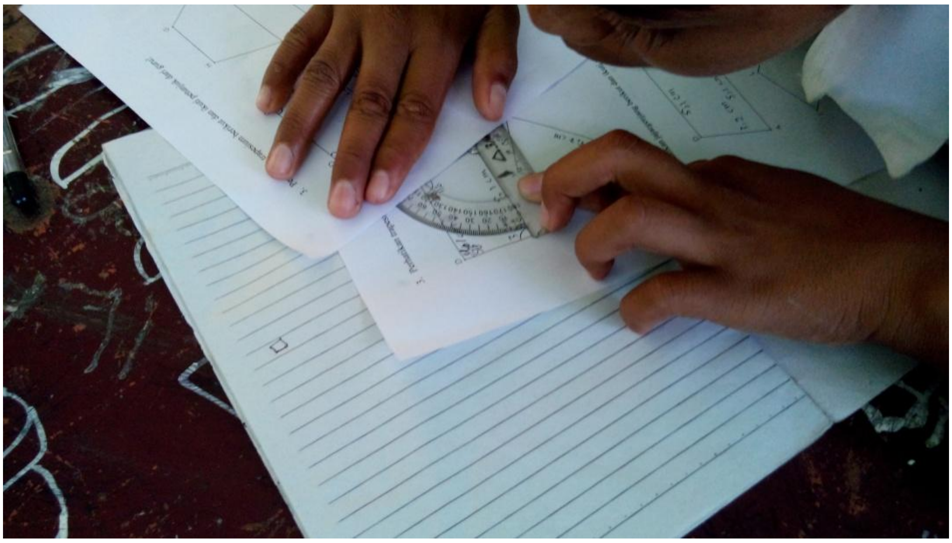

FIGURE 3. USING PAPER TO SOLVE PROBLEM FACED WHEN USING PROTRACTOR

Changes that occur in try-out of instructional materials are adding the number of each one meeting both in the classroom and in the laboratory. The addition of class activities aim to improve students' skills in using tools such as a ruler, protractor, and compass. The addition of one session in the laboratory was to equip students in the introduction of several *tools* that will be used in learning activities with the program of GeoGebra.

On going evaluation done at this preliminary stage and this stage ends with a series of tests of mathematical discovery ability of students. Test results showed that there were significant differences between the ability of mathematical discovery ability of these two classes. Students' mathematical discoveries ability taught with problem-based learning aided dynamic mathematics software GeoGebra higher than Students' mathematical discoveries ability taught traditional teaching.

Knowledge can only be derived from experience [33]. Efforts to provide GeoGebra software assisted problem-based learning experience to gain knowledge of mathematical discoveries have been able to meet expectations. It is thought to relate to the mastery of basic skills are mastered by the student, such as understanding the symbols and terms. Therefore, efforts to maintain this situation are to re-construct the prior knowledge through learning design that has been improved so that the advantages contained in the PBL can be maximized. An example is to maximize the role of cooperation in groups where individuals can mutually help each other in constructing knowledge through social interaction and culture [34].

The prior knowledge that students have mastered a necessary condition to make a conjecture by following the instructions presented. Most of the students in this study suggest that they do follow the instructions given and some others still have a problem in the use of tools, such as the compass and protractor. Although finding the conjecture is the first step in discovering mathematics [35] but with not good abilities of the students will cause problems for students to gain conjecture expected.

There are similarities with the research results of several previous studies. Previous studies showed that problem-based learning has effect to increase a variety of mathematical ability of students. One study concluded that the quality improvement of the ability to think critically, creatively, and mathematical reflective and self-regulated learning by using problem-based learning is better than the students who are learning mathematics traditionally [36]. Problem-based learning also showed better results when compared to traditional learning in terms of improving mathematical communication skills, mathematical problem solving ability, mathematical disposition of students [37].

Problem-based learning is superior to traditional learning in enhancing the ability of mathematical reasoning, mathematical communication, and emotional intelligence of students [38]. Problem solving skills, communication, and the mathematical representation of students who get problem-based learning was better than students who received traditional learning [39].

The combination of problem-based learning model or other strategies also showed good results. This can be demonstrated by the high-level mathematical thinking skills and self-regulated learning of students using problem-based approach to setting Jigsaw type of cooperative is better than the high-level mathematical thinking skills students are learning to use a problem-based approach [40]. The ability to think critically, creatively mathematical, and attitudes of students who received problem-based learning with cognitive conflict strategy was better than students who received traditional learning. Combine above suggests that problem-based learning is an instructional approach it is possible to be combined with learning, strategy, or other learning tools [41].

Integrating technology (GeoGebra) in PBL apparently showed satisfactory results. Separately GeoGebra can make students better understanding [11]. Additionally, with the ability to visually GeoGebra, students can also see the abstract concept [9]. Ease of use GeoGebra also allows users to conduct investigations, observing theorem, and make conjecture [15] that GeoGebra can be used in mathematical discovery [10].

In essence, combining the advantages of PBL and GeoGebra is something very interesting. PBL can affect the motivation of students [42]. On the other hand, GeoGebra can help students to learn mathematics well [12]. High students' motivation to learn is supported by the media that makes learning better is one of the modals can be maximized to get better learning outcomes. PBL requires the active participation of students in the class [16] and GeoGebra provide flexibility to students to learn and discover the properties of geometric objects [14].

Application of PBL and GeoGebra in the classroom this research has an impact on the ability of students' mathematical discovery. PBL learning environments expecting many solutions to the problems presented in the study. It is expected to be a valuable experience of students who certainly will not be found in traditional learning activities. PBL expects students to have the skills of problem solving and critical thinking [42] and support GeoGebra as a medium to improve the quality of learning [18] is expected to train a variety of skills, one of which is the skill of reasoning [43]. Reasoning ability is important in mathematics and mathematical reasoning is a key part of mathematical discovery [44].

IV. CONCLUSIONS

The main objective of this research is to produce instructional materials that meet the criteria expected and have a better impact in mathematics. Based on analysis data conclude that the teaching materials developed have met the criteria expected and have a better impact than traditional learning. Therefore, the researchers recommended that the teaching materials developed can be used in advanced research stage or can be used in the classroom.

Researchers who want to do research related to technology should consider two things. The first is the selection of the appropriate method or approach to a subject matter and the ability of students to be developed. It requires thinking how to look at the problems faced by students up to look for alternative solutions. The second is the allocation of time between activities in the laboratory and in the classroom. More or less time in the lab activities will certainly affect the ability of students to be measured. The learning activities which all activities are spent at the computer laboratory certainly will affect the students' ability or skill in using geometric construction tools, such as ruler, compass, and protector. One of the recommendations of researchers for researchers who study geometry problems with technology are necessary to be undertaken a study evaluating the impact of the quantity of learning activities in a computer lab on the ability or the student's skills in constructing a geometric object and find out the percentage of ideal between the number of hours of activity in the laboratory and in the classroom so that the student's skills in constructing geometrical object either manually nor using technology be able to enhance.

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Building Student's Honesty Through Contextual Mathematics Learning

Membangun Jiwa Kejujuran Siswa Melalui Pembelajaran Matematika Kontekstual

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Abstract—The character of honesty is very important in every aspect of life and human' soul. Building student's honesty will be a problem solution faced by our nation today and in the future. Honesty is needed to strengthen the development of mental, physical and spiritual for each student. Without honesty, the students and the next generation will face various problems in the future. So, they will be difficult to establish their identity, improve their potential and build social credibility. Student's honesty can be trained and developed by learning in classroom, especially in mathematics learning. Contextual learning based on intelligence is suitable for building the student's character of honesty because teacher will represent the real world in teaching and learning process and encourage the student to make connections between knowledge and application in their daily lives. Eventhough, the student should find skill and knowledge from the limited context, but they should know how to construct the knowledge for solving a problem in their life. All of teachers should realize that all of students have the different ability and knowledge is one of aspects to get closer to the greatness of God and the reality of life can give a training for student to construct mathematics in their daily lives as an effort to build student's honesty for next generation in the future.

Keywords: *contextual, honesty, learning, mathematics*

I. INTRODUCTION

Image of education today is the result of education in the past and will be a large aspect for education in the future. The success of education today will give the positive effect for education in the future. Education is one of many aspects for building the student's character. Doing a mistake for educating gives different result of our expectation which can effect for student's life in the future. As we know, student will face a real life and different problems. So, educator should teach the best for good effect in education result.

Mathematics is one of subjects which can foster and implement value of the culture and character. In Indonesian schools, Mathematical learning always has a large contribution to build student's value of the cultural and character such as honest, independent, persistent and creative. This was confirmed by the Law of the Republic of Indonesia Number 20 of 2003 on National Education article 3: "The National Education serves to develop skills and build the character and civilization of the nation's dignity in the context of the intellectual life of the nation and is aimed at developing students' potentials noble, healthy, knowledgeable, capable, creative, independent, and become citizens of a democratic and responsible". Based on this law, education has duty to build student's value of the culture and character.

Mathematics always in human's daily life. Human;s life make a circle social for interaction. These interactions should contain an honesty. For example, using a number in our interaction for describing a distance, age, weight, price and amount etc. Indirectly, mathematics may teach implementation of someone's honesty. This character be a wish to keep being implemented and developed in our lives. So that, this paper which is our effort to develop an honesty implementation in concept of mathematics learning. As an educators to be, we should give an effort in our nation education to build an honesty character.

II. CONTENT

A. *Mathematics builds what the character is*

Gardner who is a director of Project Zero at the Harvard Graduate School of Education declares a development for thinking method, well known as Multiple Intelligence. One of Multiple Intelligence Theory is intrapersonal intelligence. This intelligence is most personal, and need more other intelligences such as social environtment for interaction and cooperation in a teamwork to understand someone's intrapersonal intelligence [1]. Teamwork in mathematics learning is applied in cooperative learning. Cooperative learning which can contain a contextual problem will train a value of honesty in theirself.

Mathematics teach us to think from a smallest structure and its development. Sumardyono has a describe about mathematics as following below[8].:

- Mathematics is an organized structure. Mathematics has component axioms and theorem which discuss the concept of mathematics development.
- Mathematics is as a tool. To solve problems in daily life can use mathematics. For example, process to buy and sell a product.
- Mathematics is a deductive thinking. Deductive is a way to accept a truth and be proved in general.
- Mathematics is reasoning thinking. Reasoning is a way to prove and be thought by systematic and organized.
- Mathematics uses artificial language. Language of mathematics uses symbolic language and meaning in certain contexts. According to Galileo Galilei, Mathematics is a universal language, it means, the meaning match to context and reasoning.
- Mathematics is a creative art. Learning mathematics has connection to answer a question and prove a theorema with a lot of way from those. The context of mathematics learning teach us to know how to understand, express a creativity, use a lot of methods to students about the material. Honesty is a truth, the truth which would have real evidence.

B. *Build mathematics concept*

Romberg, a mathematician, says that mathematics has discipline about knowledge. Mathematics has concered structure of language, logic dan everything need to be observant [2]. Mathematics always teaches us to be cautious in attitude. That attitude should be included in mathematics learning for training student's attitude. The structure of language trains students to be careful of their speech. Building mathematics concept should contain the coherent-well basic of ideas, rules and its development. Its goal is for changing student's mindset to think mathematically. In mathematics class, teacher should have to provide an understanding concept of contextual learning analogy. So, building a structure concept of mathematics will help student to realize their honesty.

C. *Contextual Learning*

Berns and Erickson say that "*contextual teaching and learning is the concept of teaching and learning that help teachers relate subject matter content to real world situations; and motivate students to make connections between knowledge and its application to their lives as family members, citizens, and workers; and engage in the hard work that learning requires*"[3]. It becomes important to build a honesty to students. Using contextual is not only about teaching mathematics, but how to make connection to student's mindset for thinking about the real world situations and what experience their learned. That mindset which is built on learning will increase their pleased to learn mathematics and get challenges to construct knowledge from outside. For final learning, the teacher can give students assignments which is related to contextual learning materials their daily in the neighborhood.

Gardner says that Interpersonal intelligence concerns to people's social interaction. Interaction will involve a lot of questions and statements from others who needs an honesty in the process[1]. It will develop the mindset and apply one's knowledge and attitudes, especially honesty. Vygotsky emphasize the gap between what is known and what is being studied as a Zone of Proximal Development (Zone of Proximal Development) and how the importance of social interaction is[7].

- CTL and Constructivism Theory

In principle, contextual learning helps a learning and degree of intelligence possessed by students for connection to build a new knowledge. Jean Piaget also called constructivism for his beliefs through a knowledge that one's knowledge is a continuous interaction patterns[4]. It certainly gives a lot of opportunities for students or someone to build character through learning honesty and mindset while learning contextual, so the expectation of interactions that becomes more harmonious and trustworthy.

- CTL and Active Learning Theory.

Chickering and Gamson suggest that to be active, the students have to do something more than just a listening. In active learning, student's activities is not only as a listener, but also do think and explore mathematical knowledge[5]. Mathematics learning involves about teachers as facilitator and students play an active role which will make learning about life and having fun. Students will be actively looking for new things and certainly more easily understand the material.

- Brain and Brain Research Results

Jensen, a neurologist, has shown that the necessary for connection in learning is in the basic physiological functions of the human's brain[6]. The brain's ability to capture a stimulus depends on how big the activation in responding. How fast response is and activate in learning can be mathematics learning expectations.

III. CONCLUSION

The world of education gives a huge influence on the student's character, especially in mathematics education. In daily life, we use mathematics for interaction with others. Indeed, in that process should contain an honesty. In mathematics learning, teamwork which is one of interaction process is often called the cooperative learning, which can set up and train the student's character, especially the character of honesty.

Building a mathematical concept contains the coherent-well basic of ideas, rules and its development. Its goal is for changing student's mindset to think mathematically. It is same like contextual using, the contextual includes not only to teach mathematics but also how to connect students to think more about the world and learning through what they did by themselves. The interaction with others will involve a lot of questions and statements to do honesty in the process.

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Teacher's Pedagogical Content Knowledge Concerned To Students Knowledge On Quadratic Function

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Abstract—Teacher as an agent in teaching and learning process is one of five main factors in relation with the students' knowledge and comprehension in learning mathematics. Mastering the subject-matter is not enough for the teachers to make their students comprehend what are taught. The teachers need to know their students' thinking and the way to teach them in order to make them comprehend the materials easily. The participants of this study are senior high school teachers of mathematics subject whose different teaching experince: one novice teacher and one experienced teacher. The data were obtained through observation and interview which then were analyzed qualiatively. In this study, *Pedagogical Content Knowledge* (PCK) is defined as the teachers' knowledge which integrates the knowledge of mathematics content, pedagogy, and the students' thinking. The teachers' knowledge about the students, which is one of PCK components, is focused in this article, particularly the experienced teacher's knowledge about the students in mathematics subject on quadratic function materials. The teachers' knowledge about the students refers to their knowledge about students' conception and misconception. The result of this study shows that the experienced teacher identifies the possibilty of students' difficulties based on the students' responses during the learning process. The identification is still on analyzing the causes of the students' difficulties and misconception by using examples or contextual illustration which is then followed by re-explanation of the concept and the procedure to repair the students' mistakes and misconception.

Keywords*: pedagogical content knowledge, knowledge of students, misconception, quadratic function, teacher*

I. INTRODUCTION

Learning is a process of interaction among learners and educators with learning resources in a learning environment. National Council of Teachers of Mathematics (NCTM, 2000) recommended four principles of mathematics, namely (1) mathematics as a problem solving, (2) mathematics as a reasoning, (3) mathematics as a communication, and (4) mathematics as a relationship. Learning mathematics is a psychological process, the process is an active one's activity in an effort to understand and master mathematics.

Teachers must master the subjects that be taught and learned how to teach it so that students easily understand the material. Teachers who have not mastered their subject well, of course, does not have the knowledge needed to help students learn the content. Master subjects well is not enough for learning, but teachers need to master the mathematical content and know how to represent the lesson so it is easy to understand by students. Shulman (1986) explains that the Pedagogical Content Knowledge (PCK) as a special kind of knowledge that is the basic of knowledge for teachers involving linkage of various knowledge and skills about representations, analogies, examples, demonstration of a specific material that can be understood by students. PCK involves knowledge of specific topics that is easy or difficult for students and conceptions or misconceptions that may be for students related to a particular topic.

An, Klum, and Wu (2004) considers that the PCK as the knowledge of how to teach a particular material content. Further explained that knowledge of the content and pedagogical knowledge is not enough to reach effective teaching practices without the knowledge of students, curriculum, educational objectives and teaching materials. While Ball and Bass (2000) identify student difficulties related teacher knowledge and learning strategies appropriate to address the difficulties of students in mathematics as part of the pedagogical content knowledge.

Based on the definition above can be concluded that the knowledge of content or knowledge of subject matter possessed by mathematics teachers is to be transformed by benefitted various sources such as textbooks with the presentation of the concept that is easy to understand the students. In addition, teachers in transforming content of knowledge should use different representations, helps students make connections between different representations to solve mathematical problems, recognize the error of students thinking and is able to respond to student questions.

Ball, Thames, & Phelps (2008) identified components of PCK they are (1) *Knowledge of Content and Students* (KCS), (2) *Knowledge of Content and Teaching (KCT), (3) Knowledge of Content and Curriculum (KCC).* Further Ball et al explained that KCS is a teacher's knowledge of students and teachers mathematics knowledge. Teachers must identify what it looks like and what the students thought that would make them difficult to learn mathematics. While KCT is a knowledge of mathematical content and teaching. Teachers evaluate the advantages and disadvantages of the use of certain representations to teach cerain ideas and identify the different procedures and methods which are valuable instructionally. Furthermore, Kilic (2011) divided the PCK into four components, namely (1) Knowledge of Subject Matter, (2) Knowledge of Pedagogy, (3) Knowledge of Learners, and (4) knowledge of curriculum.

Teacher's knowledge of students thinking, An, Klum, and Wu (2004) identified four aspects of PCK of students' thinking. These aspects are (1) develop students ideas in mathematics, (2) overcoming students misconceptions, (3) engage students in learning mathematics, and (4) support student thinking about mathematics. Pedagogical content knowledge is a special knowledge that integrates the knowledge of mathematics with knowledge of students, learning and pedagogic. Pedagogical content knowledge is important for teaching because this knowledge can help teachers anticipate students miskonseption and difficulties in learning and is ready to provide an alternative model or explanation to overcome students misconceptions and difficulties.

Student misconceptions occur in mathematics because of the lack of students' understanding of mathematics concepts, including on the quadratic functions. Teachers should have knowledge of errors and misconceptions of students on the material being taught so that teachers focus more on the learning process by using appropriate models, methods, strategies, or approach. Zevenbergen, Dole, Wright (2004) explained that good teaching involves the teacher's knowledge of student thinking related mathematical concept and know how to lead students to construct knowledge more complex, complete, and strong by using the activities, habits, and learning environment organized.

Novak & Gowin (1984) stated that the misconception is an interpretation of the concepts in a statement that can not be accepted. While Suparno (1998) stated that the misconception is the notion that inaccurate about the concept, the use of the wrong concept, classification examples are wrong about the application of the concept, the meaning of different concepts, chaos concepts are different, and a hierarchical relationship concepts not true.

According to Moore (2006) the cause of the misconception among others: (1) a scheme that has been owned by one and fail to change, (2) a scheme that is wrong in accommodating new information, (3) the concept or the new scheme entered destructive the old schemes and cause confusion. The cause of misconceptions among other stage of cognitive development that is incompatible with the concept being studied, limit of student reasoning and wrong, the student's ability to capture and understand the concepts being studied, and motivate students to learn the concepts being taught.

According to Smith diSessa and Rochelle (Moore, 2006) that misconceptions can easily be fixed through the isolation. While Moore (2006) said "one method of remediation is by" explaining ". This means that one of the methods of remediation is to explain / clarify. While Lucariello stated that misconceptions can actually impede learning for several reasons. First, students generally do not realize that the knowledge they have is wrong. Additionally misunderstandings can be very strong in the minds of students. Besides new experiences are interpreted through a false understanding that it interferes in understanding new information.

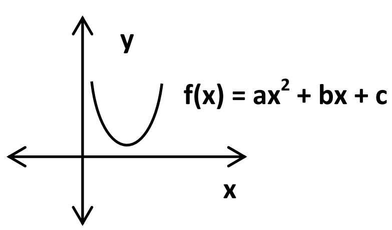
Refered to PCK of mathematics teacher in mathematics learning on this research is the kind of knowledge that integrate content knowledge, knowledge of pedagogic, and knowledge of student in learning mathematics. The purpose of this article is to describe the Pedagogical Conten Knowledge (PCK) of experienced teachers in teaching mathematics in high school related to the knowledge of students on the quadratic functions that include the teacher's knowledge of the possibility of students misconceptions, a possible source of students misconceptions, and alternative ways to overcome students misconceptions on quadratic functions.

II. METHODS

This research is a descriptive qualitative approach. The subjects were two high school mathematics teachers who teach in class X in the same school. Both subjects have qualified Bachelor of Mathematics Education. The criteria for determining the teacher as a research subject is (1) teach in class X in the same school, (2) have at least 5 years of teaching experience, (3) is willing to provide relevant data, including learning observations in each class. Subject 01 with 15 years of teaching experience (experienced teachers were given symbol S01, subjects 02 with 7 years of teaching experience (novice teachers) were given symbol S02, starting from rose to candidates for government employee.

Data were collected through classroom observations and interviews with the subject. Interview with the subject based of questionnaire of mathematics teaching adapted from An, Kulm, and Wu (2004). The questionnaire contains the results of the work of students who make mistakes in answering the question / problem given. Questions were raised on teachers with reference to the results of student work to dig teacher PCK related to teacher's knowledge of students. The questionnaire consisted of two issues that are designed to study in depth PCK related teacher knowledge of students on the topic of drawing graph quadratic functions. Teacher's knowledge of student thinking includes knowing their chances of students misconceptions, knowing the likely source of student misconceptions, and alternative ways to overcome students misconceptions.

Tabel 1 Questionnaire of Mathematics Teaching*

Problem 1	Question Items for teacher
Students class X are given a question as follow: Investigate the properties / characteristics of the values of a, b, and c of a quadratic function expressed in the image below! 	1. What do possible of each students think ? 2. If your student survive to his/her thinking. What steps will you do in order to student aware his/her error thinking ? 3. What the causes of misconception occured on each students ? 4. How alternative ways to address students miskonception that occured to each studets? 5. What questions/tasks will be given to each students to address his/her misconception?

<table>
<tr><td>
Answer of student (Mr)

If a>0, b≥0, and c ≥0 then the parabola opens upward and do not cut the x-axis and y-axis. Parabola is always on top of each x€R.

Answer of student (Dg)

If a>0, bc≥0 then the parabola opens upward and do not cut and do not tangent the x-axis and y-axis and on the positive side.

Answer of student (Ag)

Because the curve opens upward and do not intersect or tangent x-axis then

a>0, D<0, b>0, c=0
</td><td></td></tr>
<tr><td>Problem 2</td><td></td></tr>
<tr><td>
Your students are trying to solve the following problem: a bullet was fired upward so that the trajectory forms a curved parabolic with the equation $h(t) = -t^2 - 6t - 8$ where t indicates a time in seconds and h shows height in meters. How is the maximum height of bullet’s trajectory and how long it takes to reach the maximum height.

Answer of two students are as follow :

Answer of student (Ag)

$h(t) = -t^2 + 6t - 8$

$-t^2 + 6t - 8 = 0$

$(t-4)(-t+2) = 0$

$t - 4 = 0$ atau $-t + 2 = 0$

$t = 4$ atau $t = 2$

$t = 4$ $t = 2$

$h(4) = -4^2 + 6(4) - 8$ $h(2) = -2^2 + 6(2) - 8$

$= 16 + 24 - 8 = 32$ $= 4 + 12 - 8 = 8$

Maximum height is 32 meters in t = 4

Answer of student (Gn)

$h(t) = -t^2 + 6t - 8$

$t = 0$ then $y = -8$

$t = 1$ then $y = -1$

$t = 2$ then $y = 8$

Maximum height = 8 meter wit time used t = 2
</td><td>
1. What do possible of each students think ?
2. If your student survive to his/her thinking. What steps will you do in order to student aware his/her error thinking ?
3. What the causes of misconception occured on each students ?
4. How alternative ways to address students miskonception that occured to each studets ?
5. What questions/tasks will be given to each students to address his/her misconception ?
</td></tr>
</table>

*Adapted of An, Kulm, dan Wu (2004)

III. RESULT AND DISCUSSION

Results of experienced teachers PCK related to the knowledge of students on quadratic functions that include the teacher's knowledge of the possibility of student misconceptions, causing student misconceptions, and alternative ways to overcome students misconceptions.

1. Knowledge of experienced teacher of the students possible misconceptions

Experienced teacher stated that for problem 1, generally the three students had understood that when the parabola opens upward then value of a or coefficient of $x^2 > 0$. But for the coefficients b and c are still errors. The concept is not well understood is the concept of the axis of symmetry, if the picture is on the x-axis and y-axis are positive, means the axis of symmetry is positive. This is related to the coefficient b, as to define the axis of symmetry $-\frac{b}{2a}$. So, nothing to do with the value of the coefficient x that is b and the coefficient of x^2 is a. It is known that so that if the value of the symmetry of axis is positive, then the value. Mn and Ag write means that both of these students do not understand the concept of symmetry of axis. Misconceptions experienced by students that is Mn determined values of b and c, Mn write that $c \geq 0$. To determine the value of c, there is a relation with a piece of graph y-axis. If the graph intersects the y-axis, the value x = 0. Furthermore, substituting the value of x = 0 to a quadratic function, then the result $f(0) = c$. If y = c, then y is above the x-axis, then y is positive, because y = c then c is also positive, it means that c> 0. While Mn answered, whereas c> 0. The answer is not clear Dg, and Pt writes that c = 0 Dg also wrote that if the parabola opens upwards, then it did not intercept and tangent the x-axis and y-axis. That means he does not understand this image. Then for Ag true for writes that D <0, mean Ag know that if D <0, then it does not intercept the x-axis, only wrong in determining the value of b and c.

While for the second problem, an experienced teacher, stated that both students Ag and Gn do not understand the concept of the turning points of a quadratic function graph, when describing the graph function, the maximum point is at the turning point of the parabola. That is, if students understand the picture, then the student can determine its maximum height. While the procedures performed mistakes that students Ag and Gn made a mistake in calculation, here the students wrote that -4 ^ 2 = 16, should result -16. Actually Ag understand that the maximum value is the highest value, but the problem when do substitution, Ag comparing the values 32 and 8, and then the students take the value t = 4 because the value is higher, at 32. They did not understand that the maximum value is at a turning point. Gn make the same mistake with Ag namely when subtitute, when had discovered the high value, then Gn stop there and not continue any longer.

Experienced teachers know possibilities of students misconceptions on quadratic function based on the results of the students' work can be identified by seeing whether the relationship among concepts are true or false. Possible students misconceptions often occurs in the quadratic functions material that students can not interpret picture by considering the coefficients and constants of the quadratic function, the students do not understand the relationship between the intersection point of the graph with the y-axis and a constant value, do not understand the relationship of the turning point of the parabola and equation axis of symmetry , According to Kilic (2011), teachers need to identify student misconceptions and difficulties by asking or using the right task.

2. Knowledge of experienced teachers of the causes of student misconceptions

Experienced teachers stated that the probabilities cause of misconceptions students in problem 1 is the three students do not understand the beginning of knowledge related to graph of quadratic functions, for example the coordinate axes, coefficients, variables, drawing graphs of functions ever learned before. In addition, students are less precise in the applying the concepts that have been studied for instance the concept of the axis of symmetry, the point of intersection with the graph of the coordinate axes. As for the second problem of misconceptions that occur on both the students caused the students do not understand about the story that was given and did not understand the initial knowledge as the possible cause of the problem 1.

Knowing the possibilities of students misconceptions by experienced teachers can ask questions, for example, for problem 1, questions to ask coefficient what coefficient related to the x-axis, what the coefficients a, b, or c constants? As it relates to the y axis, whether the coefficients a, b, or c constants? According to Kilic (2011), teachers need to identify student misconceptions and difficulties by asking question or using the appropriate task. Moreover, teachers need to be able to determine the source of difficulties and errors so that students can be corrected appropriately.

3. Knowledge of experienced teachers of alternative ways of overcoming students misconceptions

Experienced teachers stated that alternative ways to overcome the students misconceptions for problem 1 is explained again by the students way when given a quadratic function in general, to describe exactly, students simply replace the value of a, b, c with numbers. So, to see if the picture is true or not, it should be noted the rules are a> 0, b <0, and c> 0, then the student was asked to subtitute a, b, c with value. Then the students were asked to find the value of a > 0 to subtitute the values of a. values of b <0, and c> 0. Then the students were asked to create an image of the parabola, whether the pictures are really like this. So in determining the value of a, b, and c, students could write differently for in accordance with the terms given. After the students to draw a graph of the function is by itself the students will know the characteristics of a given function of graph (in question). The problem leads to understanding of the concept, which presented a graph of the function and then the students were asked to identify the characteristics of the values of a, b and c. On the problem given a parabola opens up means the value of a> 0, then on the graph of a function can also be seen that the axis of symmetry is on the right of y-axis (positive x-axis) means the value of b was negative (b <0) because formula axis of symmetry is $\frac{-b}{2a}$ and value a> 0 so that the value of b should be negative so that the axis of symmetry obtained is positive. Furthermore, the value of c associated with the point of intersection of the y-axis, because the point of intersection of the y-axis is above the x-axis (positive y-axis) so that when x = 0 then y = c means that the value of c must be greater than zero (c> 0) for the value of y is positive. Thus, the characteristics a, b, and c for the graph on the problem 2 is a> 0, b <0 and c> 0.

To overcome problem 2, experienced teacher explain again prosedure of solving by first step determine what is known from the question, then draw it with x-axis represent time and y-axis have a height. then from pictue, equation of height parabola is $-t^2+6t-8$, then determine what asked. From the picture of parabola, student asked to determined the heighest of bullet. Of course student can detemine it, then we link to concept of graph before. Then shown the turning point, how to find it? Before had been learned that to find the turning point with axis $-\frac{b}{2a}$ ond the ordinate $\frac{-D}{4a}$, it will represent point of maximum height. Later, determined value of a=-1, b=6, dan c=-8 then subtituted to $-\frac{b}{2a}$ obtained 3. To find the height can be done by 2 ways, they are by using $\frac{-D}{4a}$ such that obtained 1 meter and the second way is to subtitute the value of t=3 to the eqution $-t^2+6t-8$ hence obtained 1 meter. So, the maximum height is 1 meter with t=3 second. If student knows concept, then they will think that way 1 and way 2 will result the same value. Because symetry of axis is point of center from the two factor means same when added $\mathbf{x_1}$ and $\mathbf{x_2}$ then divided by 2 $(x_1+x_2)/2$. Wile the material before had explained that $x_1+x_2=-b/a$. Such that formulation for symmetry of axis is $x=\frac{-b}{2a}$ and because formulation of $y=\frac{b^2-4ac}{4a}$ truely obtained when we subtiute symmetry of axis $x=\frac{-b}{2a}$ to the equation then the result is $y=a\left(\frac{-b}{2a}\right)^2+b\left(\frac{-b}{2a}\right)+c$ or when simplified the $y=\frac{b^2}{4a}-\frac{2b^2}{4a}+\frac{4ac}{4a}$ or $y=\frac{b^2-4ac}{4a}$. Means equals when value of symmetry of axis we subtitute directly by using formula of $y=\frac{b^2-4ac}{4a}$.

Experienced teachers have some alternatives to overcome the students misconceptions that explains again procedures to resolve the problem properly, using context illustrations, and use the bridge analogy, for example, problem 1, experienced teachers provide one alternative to improve the students misconceptions that is students asked to change any value of a but with the condition a> 0 or a<0. Likewise for the value of b and c. Later it would appear that although the values of a, b, and c are different, but if the condition is the same, is greater than zero or less than zero then the graph of the function will have special characteristics in terms of its location, open to the direction or intersection point toward an axis. According to Richland (2004) that reasoning analogy has an important role and is an effective strategy in learning mathematics. Using the example of the analogy is a way for teachers to improve student misconceptions. As for the second problem, an experienced teacher explains the intent of questions and troubleshooting procedures correctly. According to Moore (2006) that one of the methods of remediation is to explain / clarify.

Observing one aspect of PCK in this research is the knowledge of students which includes the teacher's knowledge of the possibility of student misconceptions, causing student misconceptions, and alternative ways to overcome students misconceptions on the quadratic functions material, especially experienced teachers. Results of research of Lee (2010) showed that teaching experience is also an important factor in the PCK of mathematics teacher. PCK contains elements of subject matter and how to teach it, as well as the knowledge of students. Ball and Bass (2000) defined that PCK is a special kind of knowledge that integrates the knowledge of mathematics teachers with the knowledge of students, learning and pedagogic. While Fennema & Franke (1992) stated that the knowledge of students is knowledge about specific student characteristics and built a classroom environment and planned an appropriate learning as needs of students.

IV. CONCLUSION

Pedagogical Content Knowledge (PCK) is the expert knowledge and special knowledge that integrates the mastery of subject matter, how to teach it, as well as the knowledge of students. Teaching experience is one of important factor in teacher’s PCK. PCK of experienced teachers related to knowledge of students on the quadratic functions material, namely: (1) determine the possibility of students misconceptions on quadratic function material that is checked weather the relationship among concepts are right or wrong; (2) investigate the possible causes of the misconceptions that students do not understand taht is the prerequisite knowledge related quadratic functions and students are less precise in applying the concepts that have been studied; (3) know the various alternative ways of overcoming misconceptions on the quadratic functions, consisted of retell the procedure to solve the problem correctly, using context illustrations, and using the example of an analogy.

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ME – 60

Actualization Pedagogical Content Knowledge (PCK) of Novice Teachers in Learning Practice at Systems of Linear Equations of Two Variables (SPLDV)

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Abstract— Pedagogical Content Knowledge (PCK) is a blend of content knowledge and pedagogical knowledge that teachers use to convey certain material to make it more easily understood by students. PCK components include: knowledge of teaching, knowledge of students, and content knowledge. Research of PCK on previous study more focus on the knowledge of teachers and little has been linked with learning practice of teacher in the classroom. Therefore, this study will analyze the PCK and actualization in classroom practice. This study aims to investigate the description of PCK and learning practice of novice teachers who teach mathematics at SPLDV material. PCK and learning practices comparison is based on the position of teacher PCK level compared to the level of learning practices. The approach used in this research is descriptive qualitative approach. The participants in this study were two novice teachers (teaching experience less than 3 years), with details of the first participant is already certified novice teachers through professional education of teachers (PPG) and the second participant of novice teachers who have not been certified. The results of this research in general are: (1) the PCK and learning practice level of first participant are constant; (2) the PCK and learning practice level of second participant are changed.

Keywords: *Pedagogical Content Knowledge, learning practice, Systems of Linear Equations of Two Variables*

I. INTRODUCTION

Education hold an important role in the development and progress of a nation. One of the factors that determine the success of the education is the teacher (both as educators and teachers). As stated in UU No. 14 year 2005, the teachers are required to master four competencies, namely: pedagogical, professional, social, and personality. In the last 2 decades much research done on the first two competencies, namely pedagogical and professional. In general, researchers use the term Pedagogical Content Knowledge (PCK), which was first introduced by Lee Shulman in 1986. PCK is composed of two major parts of Pedagogical Knowledge and Content Knowledge.

PCK become an issue once new ideas to maximize the learning process and results, particularly in mathematics. Evidence from the field suggests that teachers of mathematics in general can be categorized into four groups, namely: (1) teachers with content knowledge and pedagogical knowledge was good; (2) teachers with good content knowledge, but have less pedagogical knowledge; (3) teachers with less content knowledge, but have a good pedagogical knowledge; and (4) teachers with content knowledge and pedagogical knowledge is lacking. Ideally a teacher into the group (1), but in fact a lot that can not be categorized into the group. By analyzing the teacher's PCK, is expected to be obtained by a consideration of information for education policy makers in the design of in-service training for teachers and pre-service training for prospective teachers.

PCK is described as a result of the integration between the understanding of teaching materials (content knowledge) and understanding the way of educating (pedagogical knowledge) that need to be owned by a teacher. Shuell and Shulman (in Eggen and Kauchak, 2007) argued that PCK is an understanding of effective learning methods to explain the specific material, as well as an understanding of what makes a particular material is easy to learn. So to be effective teachers is not enough just to have knowledge of the material (content) or pedagogical knowledge is good, but should be able to combine both in instructional practices.

Several studies of PCK among which are: 1) Speer & Wagner (2007), which concluded that the PCK and Specialized Content Knowledge (SCK) required of teachers in providing scaffolding analytic discussion process; 2) Turnuklu & Yesildere (2007) found a relationship between mathematics knowledge and PCK; 3) Margiyono & Mampow (2010) describe the PCK into seven components measured namely: (a) the knowledge of students, (b) mastery of curriculum standards, (c) mastery of the learning process, (d) knowledge of evaluation, (e) knowledge about teaching resources, (f) knowledge of the matter and (g) knowledge of the learning objectives. While Karahasan (2010) in his research describing the characteristics of PCK prospective teachers.

Several studies of PCK is still rare that examines the PCK actualization of teachers in the practice of learning in the classroom. Therefore in this study will be assessed PCK teachers associated with the learning practice in the classroom. Practice is considered the “action”, “deed” or “behavior” (Ponte and Chapman, 2008). Saxe (1999: 25) argues the practice as a social event that is repeated in daily life. According to Simon and Tzur (1997) the practice is seen as what is done, it is known, trusted, and desired by the teacher. The practice of teachers as the unity of the faith, questions, or mathematical knowledge can not be understood in isolation. (Simon and Tzur, 1997: 160).

From the above description, researchers want to know Pedagocical Content Knowledge (PCK) Novice mathematics Teachers and learning practices in the classroom through research entitled: “Actualization Pedagogical Content Knowledge (PCK) of Novice Teachers in Learning Practice at Systems of Linear Equations of Two Variables (SPLDV)”.

II. THEORETICAL FRAMEWORK

A. Pedagogical Content Knowledge (PCK)

PCK is knowledge of certain teaching materials that require knowledge and pedagogical content together. Shulman (1986) was the first to introduce the term pedagogical content knowledge. He described PCK as an understanding of how topics and strategies in specific participant areas are understood and misunderstood (Shulman, 1986). Carpenter, et al. (1988: 386) describes the PCK as: conceptual knowledge and procedural knowledge, understanding of the conceptions and misconceptions about a topic, and stages of understanding of students. PCK also include knowledge of techniques to assess student understanding and diagnosing their misconceptions, knowledge of learning strategies that can be used to connect what they learn with the knowledge that already have, and knowledge of instructional strategies to eliminate their misconceptions. PCK involves knowledge of content and students, as well as knowledge of the content and teaching.

The general belief in the community is if math teachers know math very well, he is the best person to teach mathematics. But what if the teacher does not have the knowledge to teach math? Both of them should be owned by teachers as complementary to each other. Fennema and Franke (in Turnuklu & Yesildere 2007) determine the components of teacher knowledge of mathematics as follows: (1) Knowledge of mathematics in the form of content knowledge, include: the nature of mathematics and science teachers’ mental organization; (2) knowledge of the mathematical representation; (3) knowledge of students, such as students’ knowledge of cognition; and (4) knowledge of teaching and decision making.

The first item is about conceptual understanding of mathematics. Fennema and Franke (1992) argues that if the teacher has a conceptual understanding of mathematics, it will affect classroom teaching, because it is important for teachers to have knowledge of mathematics. They also stressed the importance of representation of mathematical knowledge, because mathematics is seen as the composition of a large set of abstractions that are interrelated. If the teacher does not know how to translate abstractions into a form that allows learners to connect mathematics with what they already know, they will not learn with understanding (meaningful learning).

Knowledge of cognition of students seen as one of the important components of the teacher’s knowledge, since according to Fennema and Franke (in Turnuklu & Yesildere, 2007), learning is based on what happens in the classroom, thus, not only what students can do, but the neighborhood also important in learning. The final component of the teacher’s knowledge is knowledge about teaching and decision-making. Teacher beliefs, knowledge, judgment, and mind influence the decisions they make that affect their plans and actions in the classroom (Fennema and Franke, 1992).

Knowledge of mathematics and mathematical representations of knowledge related to content knowledge, while the students' knowledge and knowledge about teaching related pedagogical knowledge. Shulman (1995) defines content knowledge as knowledge of the subject, such as mathematics and structure. According to Shulman (1995: 130) PCK includes means representing and formulating the subject that make it easy to understand other people.

Pedagogical content knowledge (PCK) is seen as the blending of content and pedagogical into an understanding of how particular topics, problems, or issues are organized, represent, and adapted to the diverse interests and abilities of learners, and presented for instruction (Shulman, 1987). PCK is described as a result of the integration between the understanding of teaching materials (content knowledge) and understanding the way of educating (pedagogical knowledge) that need to be owned by a teacher. Shuell and Shulman (in Eggen and Kauchak, 2007) argues that PCK is an understanding of effective learning methods to explain the specific material, as well as an understanding of what makes a particular material is easy to learn.

Based on the Shulman idea (1987) on PCK, teachers can have a profound knowledge of how to teach the participant matter to students (Parker & Heywood, 2000). Shulman (1987) also states that the PCK must include knowledge of learners and their characteristics, knowledge of the context of education, knowledge of the purpose and values of education and basic philosophical seta their history. Additionally, PCK refers to the ability of teachers to transform content into forms that are pedagogically very powerful and yet adaptive to students' varying abilities (Shulman, 1987).

According to An, et al. (2004) PCK has three components: 1) Knowledge of content, 2) Knowledge of curriculum, and 3) Knowledge of teaching. An et al. (2004) also shows the importance of knowledge about teaching and they accept it as a core component of PCK. In short, as the opinion Grouws and Schultz (1996) PCK includes representation that is useful, unifying ideas, clarifying examples and counter examples, analogies help, important relationships, and relationships between ideas. According to some opinions above PCK researchers divided into three components, namely: 1) Knowledge of Teaching, 2) Knowledge of Students, and 3) Content Knowledge. Furthermore, to analyze PCK participant, the researchers used a modified framework of Karahasan (2010).

B. Learning Practice

In some studies the practice is regarded as the "action", "deed" or "behavior" (Ponte and Chapman, 2008). According to Simon and Tzur (1997) the practice is seen as what is done, it is known, trusted, and desired by the teacher. The practice of teachers as a union that can not be understood only see part of the whole, ie only see convictions, questions, or knowledge of mathematics course. (Simon and Tzur, 1997: 160). Skott (1999) emphasized the importance of the study of the reasons of teacher practice. Saxe (1999: 25) argues the practice as a social event that is repeated in daily life. A key assumption is that there is a relationship between the activities and practices of the reflective individual, because the practice of giving form and meaning in the social activities of individuals. Boaler (2003: 3) describes the practice as a repetitive activity and norms developed in the classroom from time to time, in which teachers and students involved. Boaler and Saxe common ground is the idea of stability and repeatability of practice. However, Saxe emphasized their socially organized and Boaler considers not only activity but also the norm.

If the study of practices considered as an activity, repetition, social setting and knowledge, meanings and motives of the participants, the teacher practices can be seen as the activities they perform on a regular basis, taking into account the work context, meaning and their purpose. This includes the social structure of the context and the various layers of the class, school, community, professional structures and education and social systems. But this can cause problems, as noted by Events and Schwartz (2002), which addresses the issue of interpretation of teacher practice and its implications for research. The results showed that each was given a theoretical framework are likely to bring these types of questions and the different images of different situations. Practice is too complex to be understood by one perspective alone, but by combining several theoretical approaches may be an interesting suggestion, it can enhance the legitimacy of the questions that must be addressed by researchers.

In this study teacher learning practices will be analyzed based framework used to analyze the PCK in the previous section. So it will be seen comparison between PCK owned novice teachers with learning practice in the classroom.

III. METHOD

This study used a descriptive qualitative approach. Participants consisted of 2 novice teachers with details: 1 teacher with 3 years teaching experience and has been a certified educators through professional education of teachers (PPG) and one teacher with 3 years teaching experience and do not have a teaching certificate. Data taken in this study are: (1) vignette, CoRe and PaP-eRs to portraying PCK teacher, and (2) video instructional practices, to portraying the learning practices of teachers. While the analysis include: data reduction, data presentation, and conclusion. PCK is used to analyze the modification framework Karahasan (2010) and for the analysis of instructional practices of teachers also used the same framework. To ensure the validity of the data in this study, used a technique criteria degree of confidence (credibility), namely: (1) persistence of observation, (2) triangulation, and (3) checking peers (Moleong: 2012: 327).

IV. RESULT AND DISCUSSION

A. Participant 1 (initials DA)

1. Description of PCK participant DA

a. Knowledge of Teaching

In the knowledge of teaching component, the participant of DA has been trying to construct meaning and understanding to students, for example, to understand the meaning 0 = 1, and 0 = 0 on the outcome of the elimination or substitution of the students are asked to draw a graph of the SPL, so that will be visible position of the two lines (vignette 2 and vignette 3). But in naming the conceptual knowledge needed in studying this material DA could not say with detailed and precise (CoRe 5a). As related to his role as assessor and a reminder, the participant of DA has been able to assess the results of the students' work, although not consistently (vignette 1 and vignette 5), but it also has to use assessment tests through a quiz or a daily test and non test through observation of student performance (CoRe 8). While the mention of learning steps DA has not been mentioned in detail and sequence of how learning steps that should (CoRe 6a), but DA has been able to write an experience for teaching SPLDV how should the graphical method presented, ie, before the student can draw a graph PLDV, then SPLDV graph drawing is not given in advance. Based on the description then generally it can be said that the knowledge of the participant taught DA is at "level 2".

b. Knowledge of Learners

Participant DA has done a diagnosis of students' mistakes (vignette 4, 5, 6, CoRe 7), but often are not able to explain the solution. For example, when students multiply the linear equation by 0, DA could be a decisive step was wrong, but could not specify why the step one (vignette 4). Besides DA can determine the position of the mistakes made by students during the linear equation multiply by 3 (vignette 5), but when asked to write down the correct answer DA also make mistakes count. While in facilitating students to solve problems, DA demonstrated well, for example to guide students in solving SPLDV, if it produces 0 = 1 atau 0 = 0 when eliminated or substituted then it is suggested to use graphics (vignette vignette 2 and 3). As in formulating learning objectives (CoRe 1), DA has been able to formulate objectives SPLDV quite well, whereas in explaining the importance of the conveyed material (CoRe 2) most needs to be improved. Further associated with learning resources (CoRe 6b) DA has not been able to identify the source of learning in addition to books and worksheets, for example, the classroom environment, internet, home environment, libraries, and others. Therefore, in general it can be concluded that students' knowledge of the participant DA is on the "level 1".

c. Content Knowledge

Participant DA in general form PLDV states, not to mention the condition completely, so that in response to the case of the form $0x + 0y = 0$ (vignette 4) have not been able to explain it well. Participant DA also less appropriate analogy about the story into a variable, so that when students write analogy x = notebooks and y = pencils participant considers the analogy is appropriate (vignette 1). As for the mention of procedural knowledge required in the SPLDV DA well enough to be able to mention. Likewise, the participant is good enough to use a graphical representation (vignette 2 and vignette 3), which provides an explanation for the case 0 = 1 approach charts. On the other hand, the participant DA could not say exactly material necessary prerequisite to the concept of principal PLDV, SPLDV, and completion SPLDV (CoRe 4). So in general content knowledge of the participant is still at the "level 1".

2. Description of Participant DA Learning Practice

a. Practice of Knowledge or Teaching

In general, the practice of knowledge of teaching participants DA is enough good. It can be seen from coherently learning steps, compliance RPP with learning, and use of the proper allocation of sufficient time. DA has also been trying to create learning that enable students. This can be seen when explaining the material SPLDV, DA only explained globally, the rest students are asked to discuss with the group of their friends. But if there is material that the students feel elusive, the DA also provide a more detailed explanation, for example, when describing the graphical method looks DA explained with sufficient detail so that it looks students really understand. At the time of giving explanations material, DA also keep trying to engage students, such students are invited discussion to identify examples and are not examples PLDV, terms SPLDV, and the possibilities of settlement SPLDV.

In questioning and discussion techniques, DA tried to give the widest opportunity for students to present any given task and provide the opportunity for other students to argue or comment if there are less fit their ideas. DA gives strength after no more students who commented on the presentation of the students' answers. There are things that need to be improved from the practice of knowledge of teaching participant DA, ie: not using instructional media and learning resources are used only as worksheets and textbooks. The assesment technique used DA are the observation of student activity and giving a quiz. At the end of the lesson DA invites students to conclude that the material being studied. Of such exposure could be concluded that the practice of knowledge of teaching participant DA is at "level 2".

b. Practice of Knowledge of Learners

Practice of Knowledge of Learners participant DA also looks very good. This is indicated by always around to observe student work as well as providing assistance if there are students who feel confused or have problems as long as the students do the work. In addition, each student opinion given is always appreciated by DA although these opinions may be less precise. In communicating with students DA also looks pretty good, which it is visible when DA explain to the class as well as provide an explanation when DA around watching the student's work. DA capability in engaging students in learning process is also very good, as seen during the learning DA reduced role as a demonstrator, but more often to facilitate and assist students in learning. Therefore, the general practice of Knowledge of Learners participant DA can be categorized into the "level 3".

c. Practice of Content Knowledge

In identifying the concept PLDV and SPLDV, DA has been demonstrated knowledge and ability is quite good, in addition to clarify the concept of DA provides an illustration in the form of examples and not an example. Besides DA also provide an example that requires students to think at a higher level, for example, students were told to determine whether the equation $xy + y = 3$ is PLDV or not. But the analogy, participant DA still made some mistakes such as when students write analogy m = mango, and a = apple, DA only provide a response that is true is a = 1 kg of apples, m = 1 kg mango. Whereas the correct analogy is a = price of 1 kg of apples, m = the price of 1 kg of mango. But in other cases DA has determine a precise analogy. Besides DA also uses charts to clarify the interpretation solution of SPLDV. So in general it can be concluded that the practice of the content knowledge participant DA is at "level 2".

3. Comparison of PCK and the learning practice Participant DA

To determine the comparison of PCK and learning practices participant DA, then presented comparative analysis of PCK and learning practices as table 1 below.

Table 1 Comparison of PCK and Learning Practice Participant DA

Component of PCK	**Level**	**Component of Learning Practice**	**Level**	**Comparison**
Knowledge of Teaching	Level 2	Practice of Knowledge or Teaching	Level 2	Costant
Knowledge of Learners	Level 1	Practice of Knowledge of Learners	Level 3	Changed
Content Knowledge	Level 1	Practice of Content Knowledge	Level 2	Changed

Based on Table 1 above, seen that DA can be inferred that from the three components of PCK, level of knowledge of teaching and practice of knowledge of teaching are constant, which is at level 2. According Karahasan (2010) characteristics of the knowledge of teaching at this level in general is to facilitate and guide the students rather than provide answers and explanations, assess student understanding broaden this understanding with knowledge questions mathematical further assess students' interaction with students, reward and encourage students to construct knowledge of mathematics through inquiry math, sort of topics and questions in an appropriate manner, as well as control class so create a learning environment that is democratic.

As for the components of knowledge of students and content knowledge between PCK and learning practice have level changes. Changes here seen that during the teaching practice, DA can show knowledge of learners and knowledge of content better than PCK through writing instrument. The development of the participant PCK of participant DA during teaching practice is influenced by prior educational background, where after graduating S-1 mathematics education courses, the participant of DA follows the Professional Teacher Education (PPG) during the second semester. According to Hudson (2007) pedagogical knowledge is strongly influenced by the lectures, field work, and mentor through undergraduate studies.

B. Participant 2 (initials AW)

1. Description of PCK participant AW

a. Knowledge of Teaching

Participant AW have been trying to build meaning and understanding to students, for example, to understand the meaning 0 = 1, and 0 = 0 on the outcome of the elimination or substitution of the students are asked to write down the results of the example as $0y = 1$ and $0y = 0$ (vignette 2 and vignette 3). From the form of the expected students can find relevant conclusions SPLDV solution. Besides the participant AW also has another explanation alternative is to use charts. As for the mention of conceptual knowledge required in studying this material AW could mention although still not detailed (CoRe 5a). As related to his role as assessor and a reminder, the participant AW have been able to assess the results of the students' work very well (vignette 1 and vignette 5), but it also has to use assessment tests through quizzes and non test through observation when students discuss (CoRe 8). Likewise, learning steps already prepared a detailed and sequential and reflect the learning activities that enable students (CoRe 6a). Participant AW also strive to improve the learning SPLDV, which at the first AW for teaching the lecture course there are many students who feel bored and less active in learning. But after next year AW change his method of discussion, the students become more active and increase learning motivation. Based on the description then generally it can be said that the knowledge of teaching participant DA is at "level 2".

b. Knowledge of Learners

Participant AW has been able to diagnose the mistake made by student (vignette 4, 5, 6, and CoRe 7), and able to explain the solution. For example AW can determine the position of the mistakes made by the students at the time of multiplying the number of linear equations with three (vignette 5), and can explain how the answer should be. Likewise in facilitating students to solve problems, AW demonstrated well, for example to guide students in solving SPLDV, if it produces 0 = 1 or 0 = 0 at the time eliminated or substituted, the students are asked to write down the results of the example as $0y = 1$ and $0y = 0$ (vignette 2 and vignette 3). As in formulating learning objectives (CoRe 1), AW has been able to formulate objectives SPLDV quite well, whereas in explaining the importance of the materials submitted (CoRe 2) most needs to be improved. Further associated with learning resources (CoRe 6b) AW has been able to identify the source of learning in addition to books and worksheets, for example internet. based on the description in general can be concluded that knowledge of learners of participant AW are at "level 2".

c. Content Knowledge

Participant AW in understanding the requisite of general form of PLDV, the confusion between the words "not both zero" with the word "both are not zero". Likewise in addressing the analogy x = notebooks and y = pencils AW considers the analogy is not quite right, but the participant let the student make the analogy because it is not considered a significant error (vignette 1). Participant AW also considers $0y= 1$ is equivalent to $y = 1/0$ and $0y = 0$ is equivalent to $y = 0/0$. On the other hand AW has been able to mention the material prerequisites for the material SPLDV although it is limited. As for the mention of procedural knowledge required in SPLDV participant DA well enough to be able to mention. So in general content knowledge of the participant is still at the "level 1".

2. Description of Participant AW Learning Practice

a. Practice of Knowledge of Teaching

In lessons, participant AW have tried to create a coherent teaching, although it is still not optimal. For example in initiating SPLDV material, participant AW deliver learning objectives to be achieved and also write down the main points of the material the students will learn sequentially. In addition AW also use questioning and discussion well. It is seen during learning, AW is a lot of discussion and question and answer session with the students rather than explaining the lecture method. The assessment used is the assessment process, namely through the observation of performance (activity) students in the group and at the time of presentation. At the end of the learning AW also has to do reflections by providing reinforcement to riviews and invites students to conclude that the material being studied. So generally can be inferred from the practice of knowledge of teaching participants AW is at "level 2".

b. Practice of Knowledge of Learners

During learning, AW is often seen helping students to understand and solve problems SPLDV. AW using readily accepted explanation for the students, such as students' confusion getting results 0 = 1, AW asks the students to write $0y = 1$ as another form of $0 = 1$, so that students can determine the completion of SPLDV asked. AW also seen frequently engaging students in learning, for example, students were invited together to identify the characteristics PLDV and SPLDV. Additionally, when students asked about the difficulties facing certain problems, AW did not directly answer, but it gives students the opportunity to think independently used while providing modest support (scaffolding). It can therefore be concluded that the practice of Knowledge of Learners of participant AW is at "level 3".

c. Practice of Content Knowledge

Actually, the participant AW have shown good enough content knowledge for teaching practice. But occasionally seen AW still do not understand the proper use of notation. This is for example evidenced by allowing just the students who wrote the set of solution in many ways, namely: (2,1), {2,1}, and {(2,1)}. In addition AW also allow students who write $x = \infty$ and $y = \infty$ as a form of invfinitely solution. Similarly, when explaining $0y = 0$, AW considers equivalent to $y = 0/0$, and stated $0/0 = 5$, $0/0 = -100$, $0/0 = 1/70$. Therefore, the practice of content knowledge participant AW is still at the "level 1".

3. Comparison of PCK and the learning practice Participant AW

To determine the comparison PCK and learning practices participant DA, then presented comparative analysis of PCK and learning practices as table 2 below.

Tabel 2 Comparison of PCK and the learning practice Participant AW

Component of PCK	Level	Component of Learning Practice	Level	Comparison
Knowledge of Teaching	Level 2	Practice of Knowledge or Teaching	Level 2	Costant
Knowledge of Learners	Level 3	Practice of Knowledge of Learners	Level 3	Costant
Content Knowledge	Level 2	Practice of Content Knowledge	Level 1	Changed

Based on Table 2 above can be inferred from three components of PCK, level of knowledge of teaching and knowledge of the learners constant between PCK with learning practices. This is in accordance with the opinion of Li (2009) that PCK mathematics teachers have an impact on the teaching they do is apparent not only from the object of teaching, structure of teaching, and the idea of explaining, but also from the view of education, emotional teaching, teaching design, teaching language, thinking math student, the student's learning attitude and so on.

As for the component content knowledge between PCK with learning practices level changes. Changes here seen that during the teaching practice, the content knowledge that is shown not as good AW PCK through writing instrument. This is due to the experience of teaching the participant of the new AW 2 years, so the possibility of improvisation during instructional practices are still lacking. According Gatbonton (2008) a group of experienced teachers have the pedagogical knowledge that is more detailed, particularly in regards attitudes and behavior of students.

V. CONCLUSION

The results of this study indicate that teachers in the classroom teaching practice is strongly influenced by the knowledge (PCK) about how to teach math material. In addition it was found that the quality of teaching practices are not only influenced by the teaching experience of a teacher, but also by the teachers' educational backgrounds, including education and training to improve the professionalism of teachers have been followed.

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Effectiveness of Cooperative Learning Approach (Snowball Throwing) in Logics Instruction at AMIKOM Mataram

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Abstract—This study aimed to describe effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional) and compare effectiveness of the snowball throwing's type of cooperative learning approach with conventional approaches in logics instruction seen from the aspect of student mathematics achievement in the academic year 2014/2015 at AMIKOM Mataram. The research is a quasi-experiment with nonequivalent comparison-group design. Its population is all of the student of informatics management (MI) with sample used are students of MI A and MI C+Exe. To test the effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional), data were analyzed using one sample t-test. To test that the snowball's throwing type of cooperative learning approach is more effective than conventional approach, the data were analyzed using ANOVA followed by Benferroni's t-test. The results showed that the instruction approaches (the snowball throwing's type of cooperative learning and conventional) is effective and the snowball throwing's type of cooperative learning approach is more effective than conventional approaches in logics instruction seen from the aspect of student mathematics achievement in the academic year 2014/2015 at AMIKOM Mataram.

Keywords: *the snowball throwing's type of cooperative learning approach, student mathematics achievement*

I. INTRODUCTION

Mathematics is the mother of science. The sentence is appropriate to represent the existence of mathematics to other sciences, including computer science. A person will not be clever in computer science when they are not clever in math. That is, if students of AMIKOM Mataram want to be clever or to obtain good result in the computer class, then they must have solid and good foundation.

Logic of math is one of the object of studied in mathematics. Logic of math is the basic in mathematics. Therefore, studying logic of math is compulsory for all students in AMIKOM Mataram. However, studying logic of math well, is not easy, but experienced some problems in instruction. One example of the problem is the low of student mathematics achievement in logic of math. After analyzed, one cause of the problem is an instruction approach that lecturer apply is less precise. Lecturer tend to apply a lecturer oriented learning approach (conventional approach). Therefore, implement, a student oriented learning approach is the right solution to solve the problem about the low of student mathematics achievement. One of the example of a student oriented learning approach is the snowball throwing's type of cooperative learning approach.

Furthermore, academic achievement is defined as the results obtained by the students during the learning activities take place. The results are poured in the form of a numerical rating [1]. In addition, academic achievement is also interpreted as a person's competencies that acquired after learning activities. Competence is then related to the domain of knowledge [2]. In line with this, academic achievement is also interpreted as the results obtained after the student learning process. Usually, the results are set forth in the form of numbers or values that represent them in the learning ability [3]. Based on the explanation above, in this study, student mathematics achievement is the result that be obtained after the student learning activities take place and expressed in the value form.

Simply put, cooperative learning approach is defined as an instruction approach that focuses on learning activities in small group in order that the students be able to learn and work together, giving rise to an optimal learning experience. However, not all group instruction belong to the group of cooperative learning, but must have five criteria, that is: positive interdependence, face-to-face interaction, individual responsibility, social skills, and evaluation of the group process [4].

In addition, also disclosed that the cooperative learning approach divide students into small groups with a number of membership about 4-5 people who heterogeneous [5]. Heterogeneous in the sense, heterogeneous in academic ability and gender. Furthermore, another opinion reveals that the cooperative learning approach should be based on "creation, analysis, and systematic application of structures, or content-free ways of organizing social interaction in the classroom [6]."

Cooperative learning approach consists of various types, among others: jigsaw, student-teams-achievement-divisions (STAD), think-pair-share (TPS), group-investigation (GI), and snowball throwing. In this study, the type used is the snowball throwing's type. The steps are as follows: (a) lecturers divide students in small groups (4-5 people) are heterogeneous with one member of the group as the group leader; (b) lecturers calling every group leader to get together and then given an explanation of the subject matter (the members of the group read the subject matter); (c) lecturers ask the group leader to return to their groups and then give explanations and discussion with the others member of the group about the subject matter; (d) lecturers ask each students group to create a question relating to the material on a piece of paper and then rolled into a snowball shape; (e) lecturers ask to throw a snowball that has been made to the others of student group; (F) lecturers ask each students group to answer the questions that they receive; (g) lecturers ask some groups to present and discuss the subject matter and some questions received in front of the class; and (h) together with the others student, lecturers evaluate answers and learning activities that have been performed [7].

Based on the explanation above, the purpose of this study is to describe effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional) and compare effectiveness of the snowball throwing's type of cooperative learning approach with conventional approache in logics instruction seen from the aspect of student mathematics achievement in the academic year 2014/2015 at AMIKOM Mataram. In addition, the presence of this study are expected to provide a contribution to learning in AMIKOM Mataram, particularly with regard to the snowball throwing's type of cooperative learning approach. As reinforcement in this study, with regard to the effectiveness of the snowball throwing's type of cooperative learning approach seen from the aspect of student learning achievement is supported by Agustina research conducted in 2013 which revealed that the approach is effective in terms of aspects of student learning achievement [8].

II. RESEARCH METHOD

The kind of this research is a quasi-experiment that designed use nonequivalent comparison-group design. This research was conducted at AMIKOM Mataram from October 2014 to January 2015. The population is all students of Management Information (MI) in the academic year 2014/2015, while the sample is a student of MI A and MI C+Exe (random sampling). In this study, the independent variable is the instruction approach (the snowball throwing's type of cooperative learning and conventional) and the dependent variable is student mathematics achievement. The instruments that used to measure student mathematics achievement is mathematics achievement test.

In this study, data collection techniques done by starting giving tests before treatment to graders MI A and MI C+Exe, continued with give the treatment (application of the snowball throwing's type of cooperative learning approach as experimental group and conventional approaches as control group), and ends with the provision of tests after treatment of the students in both classes. The technique of data analysis done by describing the data and inferential statistical analyzes of data obtained. Description of data is done by finding average, standard of deviation, variance, minimum score, and maximum score, both for the data before and after treatment.

One sample t-test was used to test whether the instruction approaches (the snowball throwing's type of cooperative learning and conventional approach) is effective in logic instruction seen from the aspect of student mathematics achievement. Its criteria: H_0 (instruction approach is not effective seen from the aspect of student mathematics achievement) was rejected when the significance of t is less than 0,05. Furthermore, *ANOVA* test was used to test whether there are differences of beginning knowledge between two classes sample in logics instruction seen from the aspect of student mathematics achievement. Its criteria: H_{01} (there are not differences of beginning knowledge between two classes sample) was rejected when the significance of F is less than 0,05. The same test using ANOVA was performed to test data after treatment. It is intended to see whether there are differences of effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional approach) in logics instruction seen from the aspect of student mathematics achievement. Furthermore, *Benferroni's t-test* was used to see whether the snowball throwing's type of cooperative learning approach is more effective than conventional approaches seen from the aspect of student mathematics achievement. Its criteria: H_{02} (the snowball throwing's type of cooperative learning approach less effective than conventional approaches) was rejected when the significance of t is less than 0,05.

III. RESULT AND DISCUSSION

In this study, the implementation of instruction approaches (the snowball throwing's type of cooperative learning and conventional approach) has been going as well as the instruction implementation plan. However, there are some things that must be get attention in the implementation of the snowball throwing's type of cooperative learning approach, as students asked more serious during the process of snowball throwing and ask the leader of group to learn more about the subject matter than his/her members.

Data description of student mathematics achievement for both snowball throwing class (STC) and conventional class (CC) can be seen in Tab. 1. According of Tab. 1 obtained information that the average value both before treatment is below 75 and after treatment is above 75. In addition, also obtained information that there are students who earn a perfect score (100) in class of snowball throwing. To test normality and homogeneity of data, for both STC and CC (before and after treatment) can be seen in both Tab. 2 and Tab. 3. Tab. 2 below show that the data of student mathematics achievement is normal (the significance value is more than 0,05). From Tab. 3 obtained information that the data of student mathematics achievement meets the homogeneity test because the significance value is more than 0,05.

TABLE 1. DATA DESCRIPTION OF STUDENT MATHEMATICS ACHIEVEMENT

Description	**STC**		**CC**	
	Before	***After***	***Before***	***After***
Average	32,44	91,79	34,72	81,67
Theoretical Maximum Value	100	100	100	100
Theoretical Minimum Value	0	0	0	0
Maximum Value	85	100	50	95
Minimum value	5	70	15	70
Standard of Deviation	16,29	8,62	12,87	8,7
Variance	265,62	74,32	165,66	75,71

TABLE 2. THE RESULTS OF NORMALITIY TEST

Class	**Sig.**	
	Before Treatment	***After Treatment***
Snowball Throwing	0,184	0,056
Conventional	0,07	0,487

TABLE 3. THE RESULTS OF HOMOGENEITY TEST

	Before Treatment	**After Treatment**
Sig.	0,311	0,915

TABLE 4. THE RESULTS OF ONE SAMPLE T-TEST

Aspect	**Sig.**	
	STC	***CC***
Student Mathematics Achievement	0,000	0,000

TABLE 5. THE RESULTS OF ANOVA

Treatment	**Sig.**
Before	0,505
After	0,000

TABLE 6. THE RESULT OF BENFERRONY T-TEST

Aspect	**Sig.**
Students Mathematics Achievement	0,000

Furthermore, the effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional approach) can be seen in Tab. 4. Table 4 shows that the implementation of the snowball throwing's type of cooperative learning approach is effective seen from student mathematics achievement. Besides that, the implementation of conventional approach is effective too. Those are because the significance value of *t* less than 0,05.

Test about the differences of the beginning knowledge and the effectiveness of two classes sample can be seen in Tab. 5. This table show that there are no difference of the beginning knowledge between STC and CC (the significance value is more than 0,05) and there are differences in effectiveness between STC and CC because the significance value is less than 0.05. Therefore, *Benferroni's t-test* was used to seen the differences of effectiveness between the two instruction approaches. The results of *Benferroni's t-test* can be seen in Tab. 6. Based on Tab. 6, there was information that the snowball throwing's type of cooperative learning approach is more effective than conventional approach because the significance value is less than 0,05.

The results of the above study then in line with the study of relevant theory and research which reveals that the snowball throwing's type of cooperative learning approach is effective seen from the aspect of student mathematics achievement. This is because, in instruction by using the snowball throwing type of cooperative learning approach, students are given more opportunities to interact with other students. In addition, the implementation of this approach, students felt more understand about the subject matter. This is because when students are having difficulty in learning, they tend to not be shy to ask to the leader of their respective groups. Furthermore, the snowball throwing's process is the most favorable instruction process. Although, impressed by the messing around, this process makes it look more students enjoy learning and do not feel pressured in class. The process to create questions and then answer himself was another reason why the type snowball throwing's type of cooperative learning approach is effective and more effective than conventional approach. With them create questions, they will automatically learn how to answer that question and how to correct the working of other groups.

In addition, the discussion was not only done within the scope of the group, but the scope is larger, that is class. This was apparent when the lessons that all seven do. Group of students who have problems will tend to respond in case questions were answered by another group of students who are less precise. In addition, another group of students who had come to give a response at the time of implementation of these activities. One thing that became added value in the implementation of the snowball throwing's type of cooperative learning approach is this instruction approach at least there will be some students who will be an expert student in the class, that is the leader of the group. It is seen from the results of the analysis of student mathematics achievement test that the scores of the leader of the group tend to be higher than the group members.

IV. Conclusions and Recommendations

The instruction approaches (the snowball throwing's type of cooperative learning and conventional) is effective and the snowball throwing's type of cooperative learning is more effective than conventional approaches seen from the aspect of student mathematics achievement in the academic year 2014/2015 at AMIKOM Mataram. Some things that are suggestions and needs to be follow-up of this study are: (a) although both instruction approaches (the snowball throwing's type of cooperative learning and conventional) is effective but lecturer should ask students to more serious and more encourage in order to get better output or result of the instruction, (b) a snowball throwing form can be modified to the others form, such as aircraft and plane, and (c) conduct more analysis about student's enthusiasm towards instruction approach is preferred.

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Prospective Teachers' Structure Patterns of Awareness and Regulated Thinking During Solving Problems In Algebra

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Abstract— The purpose of this study is to describe the structural pattern of awareness and regulated thinking a prospective teacher in solving problems algebra. Component awareness and regulated thinking in this study refers to attention, recall information, planning, monitoring and evaluation. This study uses a qualitative method with four subject research. The results showed that the pattern structure of awareness and regulated thinking a prospective teachers complete and incomplete. Moving is not linear, but cyclical, dynamic and repetitive.

Keywords: *Prospective Teacher, Awareness and Regulated Thinking, Solving Problem, Algebra*

I. INTRODUCTION

Metacognition important in solving the problem, Flavell (1976), Brown (1987), Nool. (2012) & Magiera (2011). Someone who has a conceptual and procedural skills are not always able to solve the problem, Kilpatrick (1985). Metacognition refers to awareness, regulated and evaluation of a person's thinking, Wilson (2001), Wilson & Clark (2004) and Magiera (2011). In this study, metacognition refers to awareness and regulated thinking. According Solso (2008) the components of awareness thinking refers to attention, architecture, recall of knowledge, emotive, novelty, emergence, selectivity and subyectivity. In this study components of awareness thinking is limited to attention and recall information. According Scraw (1995) the component of regulated thinking refers to planning, monitoring and evaluation. So in this study the components of awareness and regulated thinking refers to attention, recall information, planning, monitoring and evaluation, (Baidawi, 2015).

Attention is centering mental power to things external and internal (Solso, 2008). Attention implies a waiver of any other object that someone is able to effectively deal with the specific object (James, 1890). Attention is likened to a spotlight that focuses light beam in the direction of interest. For example, when we are on the shore, we point the spotlight on the ship that looks distant. Attention can also be transferred into the mind and memory. For example, we are able to bring the conscious mind and the memories of the past which is a feature that cooperated with the recall process knowledge / information. In terms of solving problems, attention is centering on a problem that will be solved marked with reading problems, understand the intent and purpose of the issue. Recall information / knowledge is the process of making information on the individual concerned and the world around (Solso, 2008). Awareness enables people to gain access to knowledge through the process of recall (and recognition) the information about the self and the world. The process is carried out mainly with the help of processes attentiononal conducted internally and externally.

Schraw (1994) suggested that regulated thinking refers to the planning, monitoring and evaluation. Planning is the selection of the right strategy and the allocation of resources that impact performance. Examples make predictions before reading, stringing strategies and allocate time or selectively pay attention before starting the task. Monitoring is an online awareness of completeness and performance of one's duties. The ability to test themselves or ask themselves when learning is a good example on monitoring. Evaluation is to assess the results and the process of regulated one's learning. For example, to re-evaluate one's objectives and conclusions. So regulated a prospective teacher thinking in solving algebra problems, namely, prospective teachers stringing strategy, allocate the appropriate time, to monitor and assess the performance of the completeness of the results and the process of thinking.

The purpose of this study is to describe the structure of an algebraic problem solving. Describing the structure of awareness and thought regulated a prospective teacher. So found a pattern structure awareness and thinking regulateds prospective teachers in solving algebra problems.

II. RESEARCH METHOD

The method used is qualitative research. The goal is to describe the structure of awareness and thought regulated each prospective teachers in solving algebra problems. Subjects in this study amounted to 4 students study math education programs that have take a course in elementary algebra and is already implementing the practice field experience. Instrument research that task sheet, performance and results of think aloud. Sheets task in this study as follows,

1. determine all values of a so that the linear system,

$$\begin{array}{ccccccc} x_1 & + & x_2 & - & x_3 & = & 2 \\ x_1 & + & 2x_2 & + & x_3 & = & 3 \\ x_1 & + & x_2 & + & (a^2-5)x_3 & = & a \end{array}$$

   a. have infinite many solutions
   b. not have solution
   c. having a unique solution
2. draw a graph of question in number1!
3. what can you conclude from the graph in question in number 2?

III. RESEARCH RESULT

A. The results of research on the subject 1 (S1)

The results showed that S1 has been able to apply elementary row operations on a matrix correctly. S1 perform elementary row operations to write the linear equation system in the form of a matrix and then S1 determine the main lines operate with each other. Elementary row operations performed until the matrix shaped ecelon line. After ecelon shaped line, S1 determine the value of a. S1 also been able to determine the terms linear equation system has infinitely many solutions, do not have a solution and have a unique solution. S1 has been able to draw the graph of linear equation system with infinitely many solutions, do not have a solution and a singular solution to illustrate each equation in the linear equation system and determine the cutoff point of each equation on the axis x1, x2 and x3 as in figure 1.1, 1.2 and 1.3. S1 has been able to make conclusions linear equation system has infinitely many solutions, do not have a solution and have a solution based on the graph.

Figure 1.1: graph of infinite many solutions

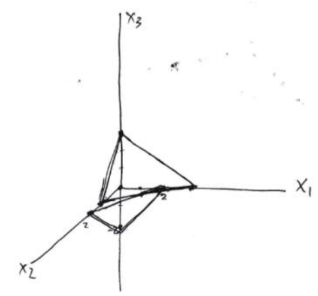


Figure 1.2: garaph of do not have a solution

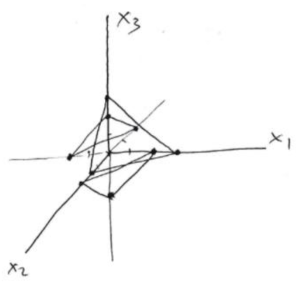
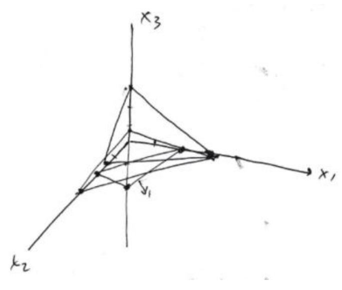
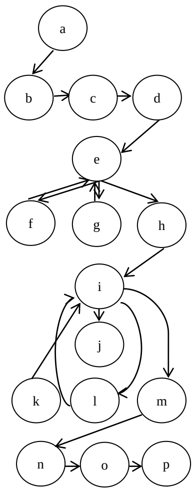


Figure 1.3: graph of unique solution



Structure of problem solving and the structure awareness and regulated thinking S1 including the complete category. Structure of problems solving and the structure awareness and regulated thinking prospective teachers are presented in Figure 1.4 and Figure 1.5 below.

Figure 1.4: Structure of solving algebra S1



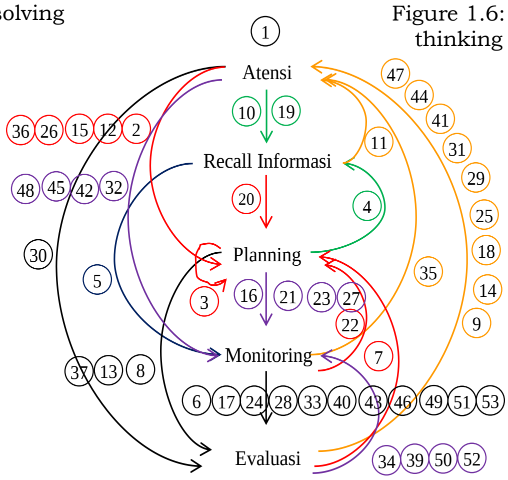
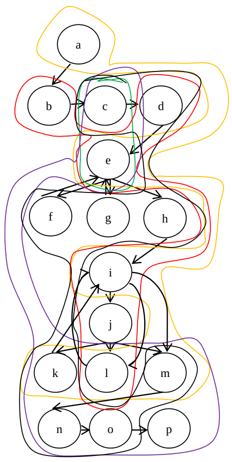


Figure 1.5: Structure awareness and regulated thinking S1

Figure 1.6: Structure awareness and regulated thinking S1 in solving problems in algebra



Caption 1.4, 1.6, 2.3, 2.5, 3.3, 3.5, 4.6 and 4.8

a : problem of linear equations systems
b : writing the augmented matrix of linear equation system
c : operate an elementary row in the matrix of the enlarged
d : forming a matrix ecelon line
e : determining requirements
f : linear equation system has infinitely many solutions
g : linear equation system not have a solution
h : linear equation system have a unique solution
i : find the value of a
j : substituting the value of a system of linear equations
k : draw graph system of linear equations with infinitely many solutions
l : draw graph with a system of linear equations do not have solutions
m : draw graph system of linear equations with a unique solution
n : summing linear equation system which has infinitely many solutions coincident graph
o : summing linear equation system that has no parallel solution curve
p : linear equation system concludes that having a unique solution curve intersect at one point
: *attention*
: *recall information*
: *planning*
: *monitoring*
: *evaluation*

From Figure 1.4 can be explained that the steps in problem solving structural move is not linear but cyclical and repetitive structure as well as the stages of awareness and thought regulated prospective teachers move is not linear but cyclical and repetitive. Completeness of the structure awareness and thought regulated S1 can be observed from the full awareness component and regulated S1 think that attention, recall information, planning, monitoring and evaluation. S1 attention when doing activities with the code a, e, i, k, l and m. Recall information on current events with a code and e. Planning once the action with the code b, d, e, i, j and l. Monitoring during activities with code c, e, k, l, m, n and o. Evaluation at the time c, d, f, g, h, k, m, n and o. as in figure 1.6.

B. The results of research on the subject 2 (S2)

S2 has been able to operate the matrix, determining the terms of linear equation system has infinitely many solutions, do not have a solution and have a unique solution. However S2 only draw the graph of each equation in the SPL. S2 has not been able to draw a graph of the linear equation system that has infinitely many solutions, do not have a solution and have a unique solution as the image around 2.1, 2.2 and 2.3. Consequently S2 can not make conclusions form graph has infinitely many solutions, do not have a solution and have a unique solution.

Figure 2.1: graph infinitely many solutions

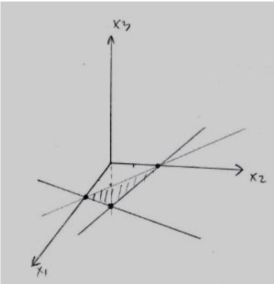
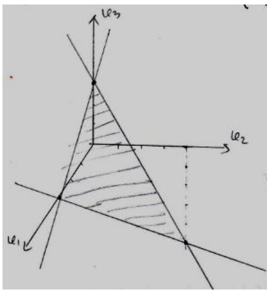


Figure 2.2: graph does not have a solution



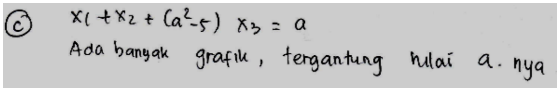
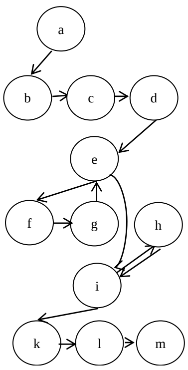


Figure 2.3: graph does not have a solution

S2 problem solving structure is incomplete as presented in Figure 2.3. S2 can not make conclusions based on the graph that is coded with n, o and p. The structure awareness and thought S2 regulated complete as presented in Figure 2.5. completeness of the structure shown by the emergence of awareness components and regulated thinks that attention, recall information, planning, monitoring and evaluation. Structure of problem solving and the structure awareness and thought regulated S2 move is not linear but cyclical, dynamic and repetitive.

Figure 2.3: Structure of solving problem algebra S2



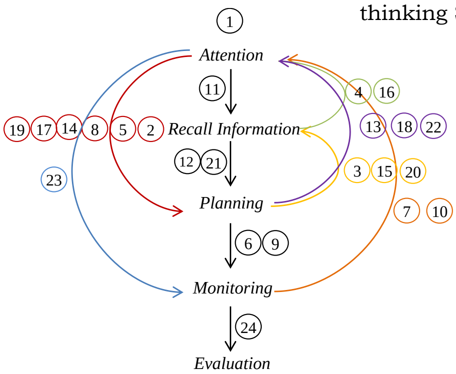
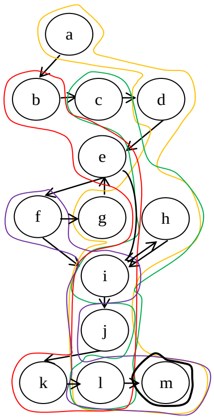


Figure 2.4: Structure of awareness and regulated thinking S2

Figure 2.5: Structure awareness and regulated thinking S2 in solving problems algebra



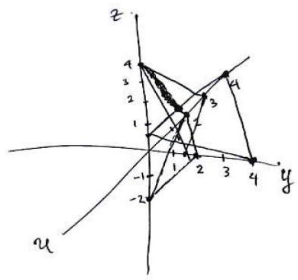
The structure awareness and regulated S2 in solving algebra problems considered incomplete because the structure is not complete solving problem. S2 did attention during activities with the code a, d, g, h, i, j, l and m. recall information on the current activities of the code c, h, i and l. Planning once the action b, e, i, j, k and l. Monitoring during activities with code f, i, l and m, evaluation once the action with the code m.

C. The results of research on the subject 3 (S3)

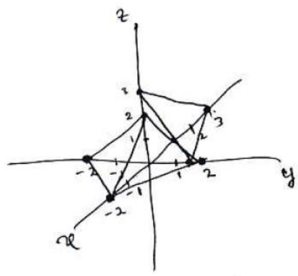
S3 was able to write the linear equation system in the form of a matrix, operate an elementary row on the matrix, determining the terms of linear equation system has infinitely many solutions, do not have a solution and have a unique solution. S3 but less careful in determining the value of a so that the linear equation system has infinitely many solutions. S3 has been able to determine the value of a so that the linear equation system does not have a solution. But not specify a value so that the linear equation system has a unique solution.

In drawing graphs SPL, S3 still fixated with the x, y and z, whereas the linear equation system using variables x1, x2 and x3. At the time of drawing graphs with infinitely many solutions, S3 is still not accurate in determining the coordinate point that should be the point lies in the positive x-axis is placed on the x-axis negative as in figure 3.1. Furthermore, since the value of a in the linear equation system which has infinitely many solutions are not right then the graph is also not right. S3 in the linear equation system graph drawing does not have a solution is still not right though the coordinates of the point of intersection of each equation is correct as in Figure 3.2. For a graphic image of the linear equation system with a unique solution, no menggamabarkan S3 graphics but simply stated that the linear equation system has a unique solution.

Gambar 3.1: graph of infinite many solution

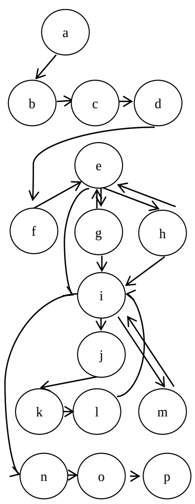


Gambar 3.2: graph of no solution



S3 in making inferences based on the chart, many states have an infinite number of solutions for the graph coincide. While the picture is not visible graph coincide. Furthermore S3 concluded not have a solution for parallel graph. Yet the picture is not visible graphic image alignment. Next S3 states have a unique solution because it has a cut-off point, but does not draw the graph S3 linear equation system with a unique solution.

Figure 3.3: Structure of solving proble algebra S3



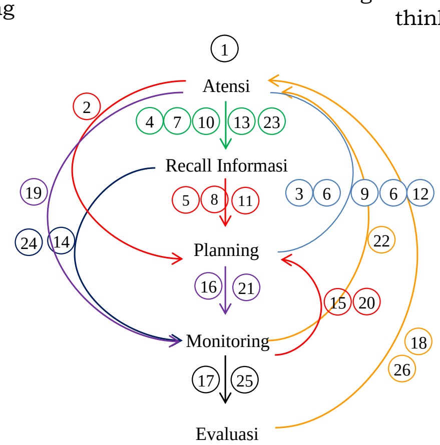
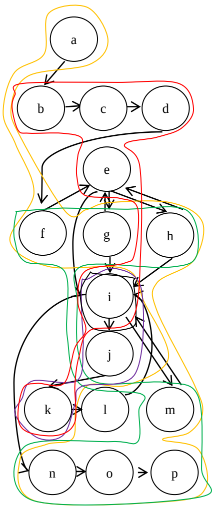


Figure 3.4: Structure awareness and regulated thinking S3

Figure 3.5: Structure of awareness and regulated thinking S3 in solving problem algebra

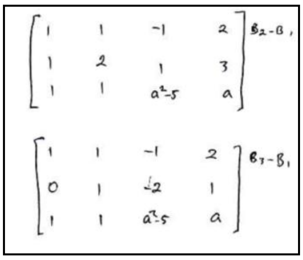


The structure of problem solving S3 including the complete category because all the code on the structure of problem solving activities have emerged as in Figure 3.3. The structure of the settlement issue in moving S3 is not linear but cyclical, dynamic and repetitive. The structure awareness and thought S3 regulated complete because all the components awareness and thinking regulateds appear. Structure awareness and regulated S3 thinking in solving problems due struktu categorized as complete problem solving and the structure of awareness and thought the regulated was complete as in figure 3.5. S3 do attention when conducting activities with the code a, f, g, h, l, m, n, o and p. Recall information when conducting activities with code f, g, h, m, n, o and p. Conduct planning at the time of activity b, c, d, i and k. Monitoring during activity i and j. Perform evaluation at the time of the code i degan activities.

D. The results of research on the subject 4 (S4)

S4 algebra problem solving begins by writing the linear equation system in the form of the augmented matrix. Then megoperasikan Gaussian elimination on the matrix. S4 less scrupulous when subtracting the second row with the third row is 1- (-1) = -2 as in figure 4.1. S4 also less careful when determining the value of a so that the linear equation system has infinitely many solutions as in Figure 4.2.

Figure 4.1: lack carefully situations in elementary row



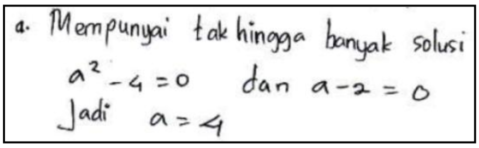


Figure 4.2: inaccuracy in determining the value of a

In describing the linear equation system graph has infinitely many solutions. S4 is not appropriate due to lack carefully situations in determining the value of a at the time of linear equation system has infinitely many solutions as in figure 4.3. S4 less appropriate to write down the coordinates of (2, 3 4/11). In determining the linear equation system does not have a solution S4 menyubstitusikan not a value that is already known in the SPL, but the S4 menyubstitusikan a value in the third equation of the linear equation system and coordinate points obtained does not refer to the equation as in Figure 4.4. As a result, the image grafiknyapun not exactly as in figure 4.5. S4 can not draw a graph of the linear equation system with a unique solution and could not make conclusions based on the graph.

Figure 4.3: graph with infinitely many solutions

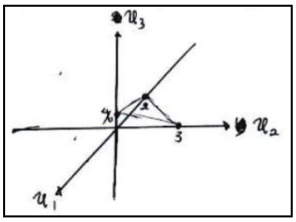


Figure 4.4: inaccuracy in determining the coordinates of the

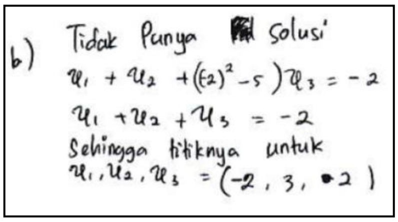
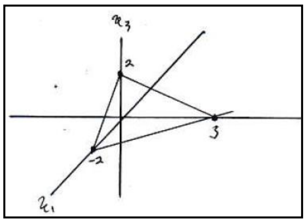
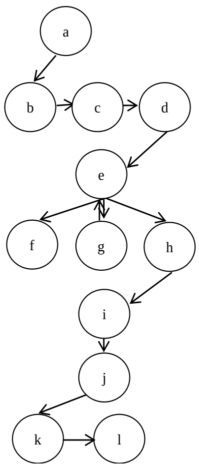


Figure 4.5: graph with no solution



Structure is not complete problem resolution S4 shown with the advent of the activities with the code m, n, o and p as in figure 4.6. The structure awareness and thought S4 regulateds including the complete category indicated by the emergence of all the components awareness and thinking regulateds as in figure 4.7. The structure awareness and thought regulated S4 included in the category is not complete because the component of the structure of problem resolution is incomplete as in figure 4.8. S4 activity attention during activities with a code, g, h and j. Recall information during activity b, c, d, g and j. Conduct planning once the action with the code b, c, d, e, f, i, j and l. Monitoring at the time b, c, d, i and k. To evaluate the current activities of the code i, j and l.

Figure 4.6: Structure of solving algebra S4



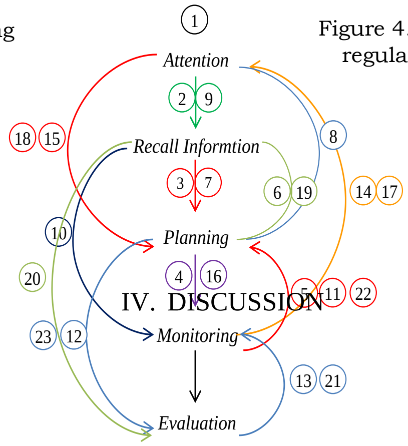
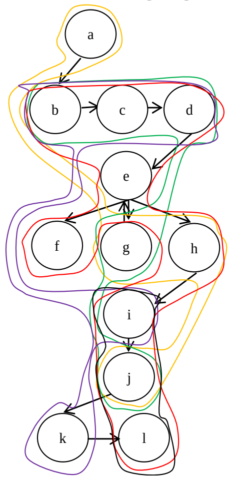


Figure 4.7: Structure awareness and thought regulated S4

Figure 4.8: Structure awareness and thought regulated S4 in solving algebra problems



IV. DISCUSSION

The structure of consciousness and thought regulated a prospective teacher has a certain pattern. The first structure of consciousness and thinking regulateds prospective teachers in solving problems categorized as complete. Structure awareness and regulated thinking in solving algebra problems incomplete if the components of the solution to the problem complete that component with activities code a, b, c, d, e, f, g, h, i, j, k, l, m, n and o , Components of awareness and regulation of thinking that attention is also complete recall information, planning, monitoring and evaluation. The second structure awareness and regulated thinking to solve problems not considered complete. Srtuktur awareness and regulation of thinking in solving problems is incomplete if the structure of the settlement of the problem, the structure of consciousness and thinking regulated incomplete. The structure of consciousness and thought regulated prospective teachers move is not linear but cyclical, dynamic and repetitive. Moving is not linear means not moving from the top down. Cyclical means moving from a component-Part kemponen to another and back again kekomonen original. Dynamic means to move up, down, and sideways. Repeats means brgerak of a component and back again kekomponen original.

In operating the elementary row prospective teachers have no problems, only S3 and S4 are less conscientious. In determining the terms of an linear equation system has infinite solutions, do not have a solution and have a unique solution Prospective teachers are also not experiencing difficulties. For a graphic image of a teacher linear equation system prospective still experiencing difficulties. S1 has been able to draw the graph properly, S2 draw graphics still fixated on each equation. S3 draw a graph with the steps that are appropriate but in determining the coordinates of the point of intersection is still not right. S4 in drawing the graph is still not right. In making conclusions based on the chart, 2 prospective teachers have been able to conclude that the graph which coincides have infinitely many solutions, which do not intersect the graph does not have a solution and a chart that has a cut-off point has a solution. 2 prospective teachers can not make conclusions based on the graph because the graph is still fixated on the image of each equation is not in the SPL. This is in accordance with the opinion of Kilpatrick (1985) that a person who has a conceptual and procedural skills are not always able to solve the problem.

V. CONCLUSION

The results of the study according to the study of theory that awareness structural components and arrangements of prospective teachers thinking in solving algebra problems referring to attention, recall information, planning, monitoring and evaluation. The structure awareness and thought regulated prospective teachers move is not linear, but cyclical, dynamic and repetitive. The structure awareness and thought regulated S1dan S3 in solving algebra problems including the complete category. While solving algebraic structure S2 and S4 included in the category is not complete.

Component structure awareness and regulation think prospective teachers in this study still refer to attention, recall information, planning, monitoring and evaluation. For further research component of awareness and thinking can be developed regulated. Categorizing the structure of awareness and thinking regulateds can also be developed. Important also involves awareness and thinking in a learning regulated.

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ME – 63

Authentic Assessment On Mathematics Education Research Methodology Course Based Group Discussion

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***Abstract*—**This research is a quasi experimental study (Quasi Experimental). The variables examined in this research consisted of independent variables and the dependent variable. The independent variable is applying assessment based group discussions, while the dependent variable is the learning achievement of mathematics education research methodology. The research design is the post test control group only design involving two groups: an experimental group and a control group. The experimental group applied assessment based discussion group, while the control group did not applied assessment based discussion groups. The population is the students sixth semester of mathematics education University of Cokroaminoto Palopo. Technique of sampling used purposive sampling based of heterogeneous class, the class chosed are class VI-A and class VI-B that each consist of 40 students from six classes. Learning achievement of students were taught using assessment based group discussions are in good category with an average score is 70.55 from the ideal score of 100, with a standard deviation is 10.11. Learning achievement of student were taught using conventional approaches are in a average category the average score is 58.93 from the ideal score of 100, with a standard deviation of 10.25. Students learning achievement of mathematics education research methodology course were taught applying assessment based group discussion is better than students learning achivement of mathematics education research methodology course were taught using conventional approaches at the significance level α = 0.05.

Keyword: *Assessment, group discussion, learning*

I. INTRODUCTION

Mathematics education research methodology was taught to students at university. The fundamental course and necessary in order to be able to master science and technology and also research. The realization of the importance of educational research methodology courses reflected to the placement of mathematics education research methodology as one of the basic research course for all students in mathematics education.

Start from the improvement of the quality of education, the educator or lecturer play a key role, especially in the implementation of the learning process. Similarly, the learner or student also play an important role in achieving the goals of education, especially in terms of accepting the course material.

The application of a method of teaching should be reviewed for effectiveness, effeciency, and compatibility with the characteristics of the course material as well as the state of the student involving ability, speed of learning, interest, time owned and socio-economic situation as a subject of study. One indicator of the quality of education in university can be seen from the student learning achievement. Student learning achievement is determined by various factors, including; how lecturer teachs, tools used for conveying the course matter, how lecturer provide motivation to students in order to student is happy and keep to learn.

Various problems of teaching and learning mathematics education research methodology in college these days, it is time to overcome. More specifically in the sixth semester mathematics education courses University of Cokroaminoto Palopo, has been investigated from the beginning that the educators have not found the learning achievement of mathematics education research methodology as expected. Regarding the evaluation system in the university lecturer have not yet implemented assessment based group discussions, as is known about the evaluation system is not suitable method or manner of assessment based real group discussion.

The assessment or evaluation has been dominated by test or a written assessment form. By written tests educators can assess a variety of things but not all the results of the learning process can be evaluated by the form. Many situations of assessment, where educators require non written test to determine the ability of students. In this case, the assessment in its application are required to use two forms of these tests are based assessment group discussions, so that in this study the evaluation system applied in the sixth semester mathematics education courses University of Cokroaminoto Palopo is assessment based discussion groups.

Authentic assessment (assessment-based discussion groups) is one alternative technique of evaluation of learning achievement that can provide great opportunities or participants a broader and abilities of students during the learning process takes place. Assessment based group discussions were conducted to evaluate the extent to which students learn and apply their learning achievement?

In the application assessment based group discussions, students are required not only to understand the concept or practice, but also able to formulate problems, find solutions and to interpret the results, and students are required to take action as a form of acquisition or understanding of the material in learning.

Based of the background above, the authors are encouraged to conduct the research with the title "Autentic Assessment on Mathematics Education Research Methodology Course Based Discussion Group".

Research Statement

Based on the background that have been raised, and then to impose limits on the scope of the problem at once illustrates of this research, the reearch statement is "it have not known the processes and learning achievement of students with the application of authentic assessment in mathematics education research methodology course based discussion group. While based on the research statement, the research questions as follows:

1. How the students learning achievement of mathematics education research methodology course on sixth semester mathematics education University of Cokroaminoto Palopo will be taught by applied assesment based group discussion?
2. How the students learning achievement of mathematics education research methodology course on sixth semester mathematics education University of Cokroaminoto Palopo will be taught without applied assesment based group discussion?
3. What the students learning achievement of mathematics education research methodology course on sixth semester mathematics education University of Cokroaminoto Palopo that applied assesment based group discussion better than without applied assesment based group discussion?

II. LITERATURE REVIEW

A. Essence of Mathematics Education Research Methodology Learning

Learning is a mental activity that can not be observed from the outside. Learning achievements can only be observed when someone appeared capabilities that have been acquired through learning. Knowledge, skills, habits, interests and attitudes are formed, modified and evolved due to learning.

According to Morgan (in Ratumanan, 2004) learning can be defined as "Any change in behavior that is relatively fixed and occurs as a result of training or experience." In line with that Rebber (in Ratumanan 2004) argues that "Learning is a are relatively permanent change in response potentiality roomates Occurs as a result of reinforced practice model, "learning is a change in the ability to react relatively fixed as a result of the exercise reinforced.

The two definition given above shows that the orientation of learning is not solely on the "results", but also on the "process", thus learning are activities that result in changes to the individual, the change in the form of new capabilities in response to a particular situation, the new capabilities can survive and function in a relatively long time, and not because the process of physical growth but for their individual effort.

Slameto (2003) suggested that teaching is an activity to try to help, lead a person to obtain, modify or develop the skills (skills), attitude (attitude), ideals (ideals), appreciations (awards), and knowledge (knowledge). Furthermore Hudoyo (1990) states that teaching is an activity undertaken by the teacher to impart knowledge / experience that has to learners. From the definition it can be concluded that the teaching on hekekatnya is the process of delivering knowledge / experience to the learners so that learners can achieve learning goals.

According Marpaung (2003) paradigm of teaching has characteristics, among others: (1) teachers active, students passive, (2) learning centers on teachers, (3) the teacher transfer knowledge to students, (4) understanding obtained by students tend merely instrumental, (5) learning is mechanistic, and (6) students be quiet (physically) and full consentration (mental) pay attention to what the teacher taught. Furthermore, it was revealed that the learning outcomes are based on the paradigm of teaching, among others, (1) many students who are not happy in the methodology of the study of mathematics education, (2) students' understanding of the methodology of the study of mathematics education is still low, and (3) ability to solve problems (problem solving), reasoning (reasoning), communicating mathematically (communication), and see the connection between concepts and rules (connection) is low. Thus, it can be argued that in order to support the achievement of learning goals of mathematics education research methodology and improve its quality, the teaching paradigm needs to be fixed.

Learning mathematics education research methodology is a psychological process, the process is an active one's activity in an effort to understand and master the mathematics education research methodology. The essence of learning mathematics education research methodology was strongly associated with the characteristics of mathematics education research methodology as school subjects. According Soedjadi (2000) suggests several characteristics of the research methodology of mathematics education, namely: (1) object of study is abstract, (2) rests on the agreement, (3) deductive mindset, (4) has a symbol that was empty of meaning, (4) pay attention to the universe of discourse, (6) consistent in its system.

Beagle (1979) suggests four kinds of objects of mathematics education research methodology, ie facts, concepts, operations, principle. Mathematics education research methodology with regard to abstract ideas by symbols arranged in a hierarchical and deductive reasoning, thus learning of mathematics education research methodology is a high mental activity. Because mathematics education research methodology are abstract ideas by means of symbols, then before understanding the symbols, it must first be understood the ideas contained therein. In connection with the symbols in mathematics education research methodology, Soedjadi (2000) argue that there are symbols that have been given a special meaning, but generally empty of meaning. This indicates that the symbol can still be given a specific meaning in accordance with the scope or his universe.

Mathematics education research methodology serves as a tool, mindset, and science. Serves as a tool, because the methodology of the study of mathematics education is often used in solving problems in other subjects, serves as the formation of mindset, because in learning research methodology of mathematics education, students accustomed to gain understanding through the experiences of the properties owned and are not possessed of a set of objects (abstraction), the surveillance of examples and are not examples of expected student is able to capture the sense of a concept. Furthermore, with this abstraction, students are trained to make predictions, guesses, or trends based on experience or knowledge developed through specific examples, nor that the methodology of the study of mathematics education as a science, for mathematics education research methodology is always searching for the truth. The research methodology school mathematics education serves to develop the ability of counting, measuring, and using the formula lowers mathematics education research methodology needed in everyday life.

B. Learning Achievement of Mathematics Education Research Mehodology

According to the psychological sense, learning is a change that is a change in behavior as a result of interaction with the environment in meeting their needs. These changes will be evident in all aspects of behavior. Definition of learning proposed by Slameto (1995) can be defined that learning is a process that is carried out by someone to obtain a new change in behavior as a whole, as a result of his own experience in interaction with the environment.

From the opinion that the thesis of this article is intended or learning is a change in behavior in a person as a result of interaction with the environment. The changes include changes in knowledge, attitudes / behaviors, skills, skills, capabilities and other aspects that exist in each individual study.

Learning achievement expressed by Mulyono (Jusriah, 2005) are as follows: "The learning achievment is the ability gained after the child through learning activities."

This is in line with the opinion of Keller (Jusriah, 2005) which defines learning achievement as follows: "The result of learning is the actual accomplishment shown by the child while the business is an act directed at the completion of learning tasks."

Learning achievement are influenced by:

a. The amount of work done child / student.
b. Intelligence and mastery of early children / students about the material to be studied.
c. The existence of the opportunity given to children / students.
d. The amount of effort that is poured and the opportunity given to children / students.
e. The consequence of learning outcomes.

Assessing the learning achievement of mathematics educationa research methodology commonly use the test. The main intention of the test is to measure the learning achievement achieved by someone who learned mathematics education research methodology. In addition, tests were also obtained to determine how much understanding they have learned the material.

According to Popham W. J. that the achievement test is important in knowing the level of score, with the reasons for the grade level teachers will be able to know to what extent the ability of students in the school on a particular subject (Nelly, 2006).

Learning achievement achieved by students could be identified after following the learning process. Learning achievement achieved one can be an indicator of the limits, abilities, knowledge, skills and attitudes or values that are owned by that person in a job. Soedjiarto (in Nelly 2006) suggests that the learning outcomes are achieved by the mastery level students in following the teaching and learning program in accordance with the purpose of education is expected. Learning outcomes in this regard include the insights of cognitive, affective and ability or skill to a student.

Based on these descriptions, it is the learning achievement of mathematics education research methodology was achieved mastery level students in the learning process of mathematics education research methodology in accordance with the objectives to be achieved. The results achieved by pupils is a picture of the success of the learning process.

C. Essence of Assesment

Assessment is gathering information on changes in the quality and quantity of student or group. In the book Assessment Based Competency explained that the assessment is an activity to obtain information about the achievements and progress of student learning and make effective use of information to achieve educational goals.

Assessment is also a process of inference various facts and made basic professional consideration to take the policy on collection of information, which contains information about the learners. Therefore, the assessment helps teachers and educators to plan curriculum and instruction in teaching and learning program, then the assessment requires information that varies from each individual or group of educators and learners.

D. Hypothesis

Based of the theoretical framework explanation then the hypothesis in this research is:
"Learning achievement mathematics education research methodology at student class VI-A Mathematics Education University of Cokroaminoto Palopo taught with assessment based group discussion is better than learning achievement mathematics education research methodology of students class VI-B Mathematics Education University of Cokroaminoto Palopo without applying assessment based discussion group"

III. METHODS

A. Variable and Research Design

This research is a quasi experimental research. The variables examined in this research consisted of independent variables and the dependent variable. The independent variable is application of assessment based group discussions, while the dependent variable is the learning achievement of mathematics education research methodology.

The research design used in this research is the only post test control group design involving two groups: one as an experimental group and one as a control group. The experimental group applied assessment based discussion group and the control group with no applied assessment based discussion groups.

Table 2. Model of research design (Arikunto, 2001).

Group	Treatment	Post test
A	Applying asssesment based group discussion	T
B	witout applying assesment based group discussion	T

Explanation :

A = Eksperimental group
B = Control group
T = Test of learning achievement

B. Operational Definision

Operationally, the variables that were examined in this study can be explained as follows:

1. Assessment based group discussion in this research is an evaluation process of the appearance of influencing the achievement of student learning, motivation and behavior within the scope of activities interconnected instructional.
2. Learning achievement of educational research methodology of mathematics education research methodology defined as the value that indicates the level of mastery of the subject matter of mathematics education research methodology derived from the provision of achievement test in the control group and the experimental group.
3. Learning activities are all activities done by the students during the learning process, either the ability or cognitive skills (knowledge) and psychomotor (practical work) obtained from non-test assessment sheet melalaui observations (observation).

C. Population and Sample

Population in this research were all students of sixth semester of Mathematics Education University of Cokroaminoto Palopo. Based on a heterogeneous class, Sample was taken by purposive sampling, chose two of six parallel classes in sixth semester. The two class is a class VI-A are about 40 students and a class VII-B 40 students.

D. Time and Location

This research conducted in program of study of mathemaics education at University of Cokroaminoto Palopo, was held during odd semester.

IV. RESULTS AND DISCUSSION

A. Results

1. Result of Descriptive Analysis

a. Students learnng achievement of mathematics education research methodology taught using mathematics education reaserch methodology with assessment based group discussion (experimental class)

The results of descriptive statistical analysis relating to the variable score student learning achievement are taught using mathematics education research methodology with assessment based group discussions are presented in Table 1 and can be seen in the attachment.

Table 1: Description of the distribution score of student learning achievement taught mathematics education research methodology applying assesment based group discussion

Statistic	Statistic Value
Size of Sample	40
Maximum Score	95
Minimum Score	50
Range	45
Mean	70,55
Standard deviation	10,11
Variance	102,31

Based on Table 1. The maximum score obtained by the student is 95, the minimum score is 50 with a range is 45. If score of learning achievement of mathematics education research methodology taught using mathematics education research methodology applying assessment based on group discussion divided into five categories, then obtained frequency distribution and percentages as shown in the following table:

Table 2. Distribution of frequency and percentage of student mathematics achievement of mathematics education research methodology taught using mathematics education research methodology applying assesment based group discussion.

Skoce	Category	Frequency	Persentage
0 – 39	Very Bad	0	0
40 – 54	Bad	3	3,8
55 – 74	Average	21	26,6
75 – 89	Good	14	17,6
90 – 100	Very Good	2	2,6

From Tables 1 and 2 above, obtained information that the average score of the students learning achievement of mathematics education research methodology taught using assessment based group discussions 71.45 of the maximum score may be achieved is 100, with a standard deviation of 11.43 and variance of 130.72. Of categorizing students learning achievement of mathematics education research methodology, it can be said that the students learning achievement of mathematics education research methodology program of study of mathematics education University of Cokroaminoto Palopo taught using mathematics education research methodology applying assessment based on group discussions considered good.

b. Student learning achievement mathematics education research methodology taught using conventional approach (Control Class)

The results of descriptive statistical analysis relating to the variable score student learning achievement are taught using conventional approaches are presented in tables 3 and can be seen in the attachment.

Tabel 3. Description of the distribution score of student learning achievement taught mathematics education research methodology applying conventional approach.

Statistic	Statistic Value
Size of Sample	40
Maximum Score	86
Minimum Score	40
Range	46
Average Score	58,93
Standard Deviation	10,25
Variance	105,09

According to the table 3 shows that the maximum score obtained for a group of students who apply conventional approaches (control class) with a maximum score is 86 and the minimum score is 40 wuth ragne is 46. If the score results of the mathematics education research methodology taught using conventional approaches grouped into five categories, the obtained frequency distribution and percentages as shown in table 4 below:

Table 4. Distribution of frequency and percentage of student mathematics achievement of mathematics education research methodology taught using mathematics education research methodology applying conventional approach (control class).

Score	Category	Frequency	Persentage
0 – 39	Very bad	0	0
40 – 54	bad	11	13,9
55 – 74	Average	18	31,2

75 – 89	Good	3	3,9
90 – 100	Very Good	0	0

From Tables 3 and 4 above, obtained information that the average score of the student learning achievement of mathematics education research methodology of program of study of mathematics education University of Cokroaminoto Palopo taught using conventional approaches for 58.93 of the maximum possible score achievable is 100, with a sandard deviation 10.25 and variance of 105.09. From students learning achievement categorization of mathematics education research methodology course, students and others in the above description, it can be said that the learning achievement of mathematics educational research methodology course of mathematics education University of Cokroaminoto Palopo taught using conventional approaches are being considered.

2. Prerequisite Analysis Test

Test of normality of the data in this research, used the assumption of Central Limit Theorem (CLT). Agung (1992) suggested that the requirements of the receipt of the assumptions or prerequisites normal distribution for sample size is sufficiently large (n = 30 or more) Further Tiro (1999) suggested that the values of n is large, $n \geq 30$, the t distribution approaches the standard normal distribution ,

This is in line with the opinion of Slaughter (1971) who argued that "The number of samples of 30 or more will provide an appropriate approximation (normal data). Although we do not impose limits on not normal or abnormal the data, the number of samples of 30 or more to meet the standard of educational research ". Because the sample of 40 people (more than 30), it can be assumed that the data in this study and the normal distribution to meet the standard of educational research.

3. Hypothesis Test

Based on the analysis, the obtained value of $t_{hit} = 5{,}105$ with significance level $\alpha = 0{,}05$ was obtained $t_{tab} = t_{(0,95;38)} = 1{,}68$ means $t_{hit} > t_{tab}$. This suggests that H_0 ignored and H_1 accepted. It can be concluded that the students learning achievements of mathematics education research methodology program of study of mathematics education of students taught using assessment based group discussion is better than students learning achievements mathematics education research methodology of program of study of mathematics education of students taught using the conventional approach University of Cokroaminoto Palopo.

B. Discussion

Based on the results of descriptive analysis indicate that thestudent learning achievement of mathematics education research methodology course of program of study of mathematics education of University of Cokroaminoto Palopo taught assessment based group discussion considered good. This is seen from the average score obtained for 70.55 or 70.55% of the maximum possible score of 100 was achieved in the interval 55-74 with variance 102.305 and standard deviation of 10.11. This is due not solely due to the effect of the application of learning research methodologies mathematics education with the assessment based on group discussion in teaching methodology of the study of mathematics education, but including the variables that can not be fully controlled in this study as a way of learning, motivation, learning tools etc. However, if the effect of learning with the learning of mathematics education research methodology with assessment based discussion group is dominant in this study. Then the results of learning "good" achieved by the students because students actively in learning activities, because he thinks and uses his own ability to solve problems. Students can understand the material, because in this method the students discover and investigate its own problems given medium. This is evident from the average score obtained at 58.93 or later the problem was associated with the real world and resolve issues privately provided with the guidance of teachers.

While the results of students learning achievement of mathematics education research methodology of program of study of mathematics education University of Cokroaminoto Palopo taught using conventional approaches categorized 58.93% of the maximum possible score of 100 was achieved in the interval 55-64 with variance 105.09 and standard deviation 10.25, This happens due to the density of the given concepts students are not able to master the learning materials, teacher-centered activities so that students become passive, blocking the response of students learning and memory limit student.

Based on the above, indicate that the student learning achievement of mathematics education research methodology taught applying assessment based discussion group is better than the students learning achievements taught by conventional approach. In mathematics education research methodology with assessment based group discussions provide an opportunity to rediscover and construct concepts of mathematics education research methodology is based on a realistic problem. Realistic situation in the problem allows use informal ways to solve the problem. Classroom interaction scheme through linkages will be stronger so that their understanding of the concept itself becomes stronger construction.

V. CONCLUSION

1. Students learning achievement of mathematics education research methodology course of mathematics education of University of Cokroaminoto Palopo taught using mathematics education research methodology with assessment based on group discussions are in good category with an average score of 70.55 from the ideal score of 100, with a standard deviation of 10, 11.
2. Students learning achievement of mathematics education research methodology course of mathematics education of University of Cokroaminoto Palopo taught using conventional approaches are in an average category with the average score of 58.93 from the ideal score of 100, with a standard deviation of 10.25.
3. Students learning achievement of mathematics education research methodology of mathematics education University of Cokroaminoto Palopo taught using mathematics education research methodology with the assessment based group discussion is better than students learning achievements of mathematics education research methodology taught using conventional approaches to the significance level $\alpha = 0.05$.

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Pre-service Teacher Interpretations of Students' Mathematical Understanding

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Abstract—Teachers do not have direct access to students' mathematical understandings. However, by observing students' mathematical activities, teachers can interpret students' mathematical understandings that include hypotheses about what students know and understand. We use the point of view "the teacher's perspective from the researchers' perspectives". This paper explores the types of pre-service teacher (PSTs) interpretations of students' mathematical understanding, defined as how PSTs to give the impression, opinion, or a theoretical view of the mathematical information in the form of a students' written work in solving problems. This studies aimed to examine the kinds of preservice teacher interpretation. These studies capture work done with 42 PSTs in mathematic education programs at Muhammadiyah University of Purworejo. We give them examples of students' written works and ask them to explain what they understood. Findings illuminate the types of interpretation of the students' mathematical understanding: naive, surface, and complete interpretation. Naive Interpretation characterized by PSTs do not provide a description of students' mathematical thinking and focus on other than the students' understanding. Surface nterpretation characterized by PSTs describe student thinking in form of operation / procedure / strategy undertaken by students without giving meaning to such thinking. Complete Interpretation characterized by PSTs identify the mathematical elements of a detailed students strategy and commented that are consistent with the students' strategies.

Keywords: *interpretation, preservice teacher, mathematical understanding*

I. INTRODUCTION

Problem solving played important role in mathematics and a prominent role in mathematics education. Problem solving become one of the objectives of mathematics learning in Indonesia [2]. In the Common Core State Standards for Mathematics [4] the first principle of standard centered on problem solving - making sense of problems and persevere in solving problems. Therefore, solving problems is relevant to teachers task in teaching mathematics with understanding. Teachers should understand students' thinking to be able to manage problem solving situation in the classroom. Teacher ability to make sense of student thinking can be seen from of how teachers identify key aspects of mathematics in students' thinking during solving problem. Developing ability to interpret students' thinking enable teachers to make appropriate instructional decisions.

According to [3] although analysis of students' thinking was highlighted as one of the main tasks of teaching mathematics, identifying the mathematical ideas that are inherent in the strategy used by a student during solving problem can be difficult for teachers. Teachers often work with routine tasks and complex teaching practices. However, teachers need to know how students understand mathematical concepts to help improve their students' understanding([5]; [25]). This approach is based on listening and learning from students ([26]; [30]). In this case, the teacher must make a decision based on the students' thinking.

Identify strategies that might be used by students in solving problem enable teachers to interpret why certain problem become difficult. It also allows teachers to pose a problem considering the characteristics of students' thinking. Teachers may be able to interpret students mathematical understanding accurately if they understand the mathematical ideas that relate to a specific mathematical domains. This knowledge can help teachers to understand the characteristics that make problem difficult for students and why[10].

Relating to the relevant role of student's mathematical thinking in teaching mathematics, mathematics teacher program set several goal that is the development of teacher's ability to interpret student's mathematical thinking [27]. The idea to design learning based on the students' thinking increasing among researchers in all content area([9]; [30]; [6]; [21]). The researchers interested in examining the mathematics teacher noticed the phenomenon of the concepts they learned - noticing- in various ways. Different researchers incorporate different aspects of teachers' thinking and practices in their definition of noticing. Mason initiated noticing as potentially unintended actions than accidental actions (pottentially intentional rather than haphazard act) [13]. The center of this view is the idea that noticing is a collection of practices that are designed to sensitize ourselves so that they can see the opportunity in the future where the action is really new is not automatically out of the habit. Some researchers understand noticing as only involves a process that teachers initially see, or feel, the different aspects of classroom activities. For example, Star and Strickland [14] and Star, Lynch, and Perova [26] examined "what captured her attention (teacher), and what they miss ... when they see classroom lessons". The approach to teacher noticing, then, involves exploring what a teacher attend to as well as what the teachers decide to attend. Other researchers are interested not only in the initial screening classroom activities but also in teacher interpretation of the activity. This is a general stance taken in previous studies (eg, [1]; [18]; [19]). In particular, [20] have focused on noticing a professional vision in which teachers are selectively attend to events that happened and then draw their existing knowledge to interpret the observed events. For example, teacher noticing will include not only teachers pay attention to certain students' ideas but also what teachers understand of the idea based on their knowledge about students and mathematical content. Sherin, Russ, and Colestock [20] assumes that teacher expectations and knowledge affect how teachers view the events that occur in the classroom. Thus, understanding how teachers interpret what he felt.

Mason [12] consider the ways in which noticing has produced insights and informed action in teaching, learning, and conduct professional development related to mathematics. Constructs such as attention and intention, awareness, and consciousness not only be investigated using a discipline noticing and informed how noticing actually works, but also contribute to their appreciation for the complexity of learning and teaching mathematics. Jacobs, Lamb, & Philipp [30] take more inclusive views about teacher noticing. They define professional noticing as involve not only teachers attend to and interpreting classroom activity but also teachers plan to respond to the activity. Jacobs, Lamb, & Philipp [30] conceptualized teacher expertise in professional noticing of children's mathematical thinking as a set of three skills that are interrelated: attending to children's strategies, interpreting children's understanding, and deciding how to respond underlying children's understanding.

Other studies indicate the relevance of PSTs interpretation about students' mathematical thinking to determine the quality of mathematics teaching ([22]; [16]; [26]; [18]). Therefore, the needs of prospective teachers to based their decision on their students' understanding underlines the importance of characterizing and understanding these skills [10], This confirms the need to focus our attention on how PSTs identify and interpret student's mathematical thinking in different domains ([7]; [11]). Research on the mathematics teachers' professional development underlines the importance of pre-service teacher noticing in teaching mathematics ([30]; [13]; [8]). Researchers and mathematics teacher educators consider developing noticing as a way to identify of how teachers understand complex situation in the classroom [21]. Mason [13] introduced the notion of awareness to characterize the ability of noticing as a consequence for the organization of teacher noticing on relevant teaching events. Jacobs [30] focus on identify key aspects for the students' mathematical thinking and interpretation to make decisions in teaching mathematics.

II. PRE-SERVICE TEACHER'S INTERPRETE STUDENTS' MATHEMATICAL THINKING

Interpreting the student thinking is an essential component of high-quality learning and assessment ([24]; [28]). Focus view of interpreting the student thinking is about what can be observed from the teaching skills of PSTs pay attention to w hat students do. A key factor in interpreting the students' work is the ability to see key aspects of students' mathematical thinking (eg, [30]; [21]; [8]). Skills around noticing can be learned [30] therefore it is important to know what is already owned by PSTs to work as they enter teacher preparation.

According to [17], of pre-service teacher skills in interpreting student's thinking can be evaluated by see whether: accurately describe the students' methods; accurately characterizes student's understanding; as well as accurately anticipate students' responses based on evidence of interaction with the students. The evaluation was conducted by analyzing students' written works and interaction with students with certain standards. If no interaction with the standardized students the skills can be evaluated by whether PSTs can precisely define the appropriate response to their interpretation. Noticing of children's mathematical thinking not only requires attention to students strategies but also the interpretation of mathematical understanding is reflected in these strategies. Identify the extent to which the evidence presented PSTs in interpreting the children's understanding is not looking for the single best interpretation but rather the extent to which participants interpretation is consistent with the details of the strategy selected children and research on the development of mathematics children. Jacobs, Lamb, & Phlilipp [30] classifies the sample response within 3 scale: robust evidence, limited evidence, and lack of evidence of interpretation of the children's understanding.

Interpretation of students' mathematical thinking is giving impression, opinion, or a theoretical view towards mathematical information in the form of students' written work in solving problems. Researchers hyphotetize interpretation of PSTs into four categories: *Beyond Complete Interpretation*; *Complete Interpretation*; *Surface Interpretation*; and *Naive Interpretation.* Beyond Complete interpretation is the interpretation which is characterized by by identifying the mathematical element in the detailed students strategy and give comments relevant to the students strategy in various ways and make comments that are consistent with the strategy demonstrated and research on the development of students' understanding. Complete interpretation is the interpretation which is characterized by identifying the mathematical element in the detailed students strategy and give comments relevant to the students strategy. pre-service teacher's responses indicates strong evidence of interpretation but does not identify student's profile or relating with research on the development of students' understanding. Surface interpretation is the interpretation which is characterized by focusing on the interpretation of students' mathematical thinking by describing the student's operations / procedures / strategies without giving meaning. And then Naïve interpretations characterized by PSTs do not provide interpretations about student's mathematical thinking and have another focus (instead focus on the interpretation of students' understanding) like something they learned about the mathematical teaching and learning in general.

III. METHODOLOGY

This study aimed to analyze of how interpretation of PSTs about students' mathematical thinking. The subjects were 42 students of the 3rd year Mathematics Education Muhammadiyah University of Purworejo, 37 females and 5 males. Researchers gave them four examples of students’ written work about comparison and ask them to give an explanation of what they learned or understood about the students' understanding. Researcher using four samples of student work for each subject to obtain valid data on their interpretation. Furthermore, the researchers conducted a qualitative descriptive analysis towards their interpretation of students' mathematical thinking based indicators hyphotetized in each category. The indicators of each category are presented in the table below.

Table 1. Indicator and Descriptor of the Interpretations

Types of Interpretation	Indicator	Descriptor
1. Beyond Complete Interpretation	Interpretation characterized by PSTs identify the mathematical elements of a detailed students strategy in various ways and commenting that are consistent with the strategy presented and research on the students mathematics development.	1.1 Explains the detailed strategies of each students 1.2 Explains the process that students done in completing problems 1.3 Comment focused on the relevant mathematical details that reflected students' understanding 1.4 Recognize the strategies and understanding which did not demonstrated by children 1.5 Compare and contrast the answer / strategy students
2. Complete Interpretation	Interpretation characterized by PSTs identify the mathematical elements of a detailed students strategy and commenting that are consistent with the students’ strategies.	2.1 Explains the detailed strategies of each students 2.2 Explains the process that students done in completing problems 2.3 Comment focused on the relevant mathematical details that reflected students' understanding
3. Surface Interpretation	Interpretation characterized by PSTs describe student thinking in form of operation / procedure / strategy undertaken by students without giving meaning to such thinking.	3.1 Describes the operation / procedure that appears on the child's responses without giving meaning 3.2 Explains the students' strategies in the common sense and sometimes undefined 3.3 Provide comments that are linked to the strategy of the child, but sometimes overgeneralized. 3.4 Using a common phrase and rarely mention the mathematical details in interpreting the child's understanding
4. Naive Interpretation	Interpretation characterized by PSTs do not provide a description of students 'mathematical thinking and focus on other than the students' understanding.	1.1 did not describe the students' understanding 1.2 describes what they learned or their own understanding 1.3 provide a response in the form of evaluation of learning 1.4 provide a response in the form of suggestions to improve learning 1.5 comment on the students, not towards student's understanding(less focus on the students as individu)

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IV. RESULT AND DISCUSSION

A. The attention of PSTs towards students strategies

Researchers gave subjects are four examples of students' written works. This method is used to obtain valid data on their interpretation. If at least 2 of their interpretation of the interpretation consistent 4 shows the categories of interpretation then they can be grouped in that category. Subjects were asked to attend to student's work or strategies that students use in solving the problems of comparison. Their attention was categorized into two groups that understand students strateges and groups of students who do not understand the strategy. The results showed that 27 subjects more understand the strategies that students use and 15 subjects less understand the strategies that students use. Distribution of the attention of PSTs about the problems comparison are presented in the following table.

Table 2. Distribution of PSTs attention of four problems about Comparison

Problem	Subject Understand Students strategies	Subject less Understand Students strategies	Total
1. To build a multi-storey building, a building contractor takes 15 months with 120 workers. For one thing, the contractor requires accelerated work 3 months. If, ability to work everyone equally and that the project can be completed on time, how many workers should be added?	7	4	11
2. Rani and Diki make a drink that consists of a mixture of water and orange syrup. They use the same glass, but with a different recipe, namely: Rani use 3 cups water and 2 cups of orange syrup, while Kiki use 5 cups of water and 4 glasses of orange syrup. Whose drink is more orangey?	7	3	10
3. Three hectares paddy fields cultivated with rice is expected to generate as much as 13 1/2 tons of rice for one harvest. If Mr. Alan has a 3/4 hectares of rice fields were entirely cultivated with rice, how many tons of paddy rice produced Sir Alan for one harvest?	6	5	11
4. Mira and Indah use the same provider for their Hp numbers. Mira spent pulse IDR 5000 for 3 days, while Indah spent IDR 10000 pulses for 5 days. Which of them is more efficient in the use of pulses?	7	3	10

Students' understanding of the strategy is shown by evidence of their concern about the student's work. Subject can describe and show the students' line of thought. Here is an example of how they follow the strategy of the students about Comparison. For the third problem, here are two samples of student work.

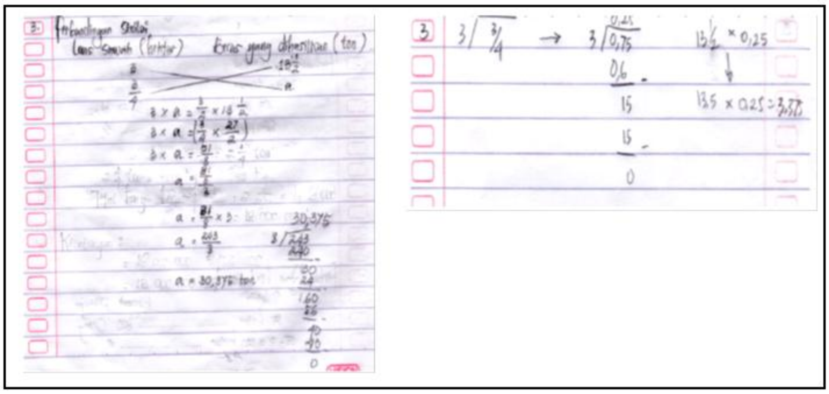

Figure 1. Sample of Students Works

Subject S9 demonstrated her understanding of strategy samples 1 and 2. She seemed to attend to students' thinking in solving the problem. Here is evidence of his attention.

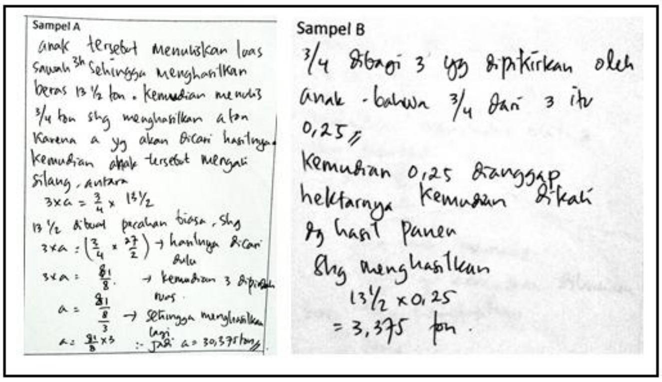

Figure 2. Subject S9 Attending to Students strategies

For sample A, she expressed her concern about the strategy to attend to students’ strategies with the student thinking at every step in the students's responses. For example

$3 \times a = ¾ \times 13 ½$

13 ½   made common fraction so

$3 \times a = (¾ \times 27/2)$ → look for the results first

$3 \times a = 81/8$ → then move 3 to other side

$a = \frac{\frac{81}{8}}{3}$ → so resulting

$a = \frac{81}{8} \times 3$

So a = 30,375 ton

Although the student answers incorrectly, she can follow student’s strategy and show students' mistakes in his interpretation. She knew that sample A make a mistake when dividing $= \frac{81}{8}$ by 3. And make a correction that it should be $= \frac{81}{8} \times \frac{1}{3}$. She was also able to follow the thought of sample 2. Sample 2 dividing ¾ to 3 in advance and multiplying the result with the harvest for 3 hectares. Then he get the result is 3,375 ton. It showed her understanding about unusually students’ work.

B. The Interpretation of PSTs towards students understanding

To describe the interpretation of PSTs about student understanding, we chose subject that shows evidence he attend to students strategies in solving problems. This is determined by consideration that subjects did not show evidence of attending to students strategies because of lack of their mathematical understanding of mathematics about problems. To be able to make interpretations, they must have an adequate mathematical understanding. Researchers hyphotetize four categories of interpretation also illustrates stage of development of interpretation. The stages of interpretation is shown in the following figure.

Naive Interpretation
↓
Surface Interpretation
↓
Complete Interpretation
↓
Beyond Complete Interpretation

Figure 3. Development Stage of Interpretation

When the subject is asked to interpret the students' understanding, mostly fixated on the instruction "Explain what you learn or understand about understanding each child". This is evident in most of the answers: the students know enough, students have good understanding of the subject , the students' understanding is still lacking, and others. Nevertheless, their interpretation can still be categorized into the following categories. That showed the early interpretation toward students’ understanding.

1. Beyond Complete Interpretation

Beyond Complete interpretation is the interpretation which is characterized by by identifying the mathematical element in the detailed students strategy and give comments relevant to the students strategy in various ways and make comments that are consistent with the strategy demonstrated and research on the development of students' understanding. Responses indicates strong evidence of interpretation. According to [30]) responses that indicates strong evidence interpretation understand the details of the strategy in different ways but all are consistent with the strategy demonstrated and research on the development of mathematics of children. The response also noted of how these details reflect what the children do not understand and recognize the strategy and understanding that are not demonstrated by the students. Researcher viewed that when the response identify mathematical elements and identifying child's thinking profiles [3] and accurately describes students methods, accurately characterize the students' understanding [17], the interpretation is belong to this category . There is no subject in this research meet those criteria. but I think that there must be a teacher candidates who meet these characteristics. this is indicated by some the subjects showed several characteristics. For example Subject 9 to problems 3, he attend to student's strategies and also shows which are not carried students the so the answer become wrong.

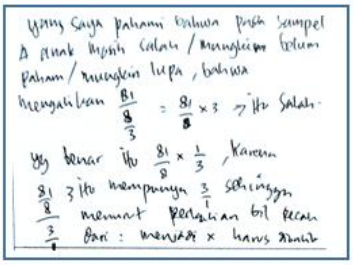

Figure 4. Interpretation S9 to Sample A written works

He understands that the sample A made mistakes in the division of fractions which cause errors in the final answer.

2. Complete Interpretation

Complete interpretation is the interpretation which is characterized by identifying the mathematical element in the detailed students strategy and give comments relevant to the students strategy. pre-service teacher's responses indicates strong evidence of interpretation but does not identify student's profile or relating with research on the development of students' understanding. S9 showed complete interpretation case.

3. Surface Interpretation

Surface interpretation is the interpretation which is characterized by focusing on the interpretation of students' mathematical thinking by describing the student's operations / procedures / strategies without giving meaning. This interpretation is conform with the interpretation that shows limited evidence of student understanding. Limited evidence, include responses in which subjects maintain a focus on interpreting the children's understanding but with a depth of less than a response that shows strong evidence [30]). Subject describes the children's understanding, but often in a broader sense that sometimes undefined. A special connection to the strategy of kids is there, but they are limited, and the conclusions that are sometimes overgeneralized, exceeded evidence presented. Responses are common, sometimes coupled with overgeneralization. The response is limited evidence still focused on interpreting the children's understanding. Subject indicates that students understand or not understand the material and observed that students are less conscientious in solving problems. subjects using the phrase student already understand or do not understand, but he does not show the mathematical details as evidence of his interpretation. For example, S2 in first problem only said that “sample A did not understand the subject and problem given”. He also said that “sample C is sufficient understand matter being taught, but students was less conscientious in solving problems”.

4. Naive Interpretation

Naïve interpretations characterized by PSTs do not provide interpretations about student's mathematical thinking and have another focus (instead focus on the interpretation of students' understanding) like something they learned about the mathematical teaching and learning in general. This interpretation does not show any evidence of their attention to the mathematical aspects of the student's work. This interpretation is consistent with the lack of evidence that the pre-service teacher / teachers interpreting. [30] indicates that some of the responses did not provide evidence of interpretation of the children's understanding, even though the participant has explicitly requested to do so ("Can you explain what you learned about the children's understanding"). This response has an alternative focus, such as something about the teaching and learning of mathematics and learning in general. This category is dominated by the subject that does not show evidence of that he understand students' strategies. For example, S4 for problem 2 interpret sample B written works by judging that Sample B seems student are lazy writing and likes to draw conclusions without reasonable cause.

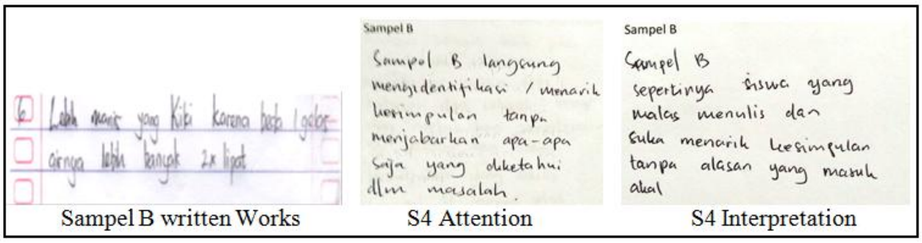

Figure 5. Comparing sample B written works, S4 Attention, and S4 Interpretation

We can compare students' understanding with understanding the subject. Although the students' answers is short, but these students demonstrate the ability to reason in comparing the two mixed drinks. Subject view that students do not understand the problem.

V. CONCLUSION

Based on the analysis, researchers concluded that pre-servive teacher interpretation are on three stage of interpretation, i.e complete interpretation, surface interretation, and naive interpretatin. However, researcher believe that beyond complete interpretation is possible bellonging by pre-service teacher. A lot of PSTs' interpretations about students' mathematical understanding at the stage of surface interpretation and complete interpretation. Their presence on this stage is not separated from their understanding about the subject matter, their pedagogical knowledge, as well as their reasoning ability. Sentence order to explain what they have learned and understood from each students understanding makes the subject stuck to interpret students' understanding to understand or not understand the problems.

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ME – 65

Development Interactive Learning Media to Excavate Ability Mathematical Creative Thinking Students

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Abstract— The purpose of this study was to design an interactive learning media, identify the beginning and end of the ability of creative thinking mathematical students, excavate student response to the implementation of media interactive learning, analyze the difficulties of mathematical creative thinking students. The method used is Research and Development, with the steps: identify of teaching material, organize media interactive learning, considered by the experts, try out media interactive learning and research instruments, examine the pre-test and post-test of mathematical creative thinking, implement of interactive learning media in Mathematics Capita Selecta course, distribute questionnaires and interviews. Data collection techniques include: media interactive learning test, mathematical creative thinking ability tests, questionnaires and interviews. The research instruments are mathematical creative thinking ability tests, questionnaires and interviews sheet. The population in this study are all students majoring in mathematics education semester of academic year 2015-2016. Sample used is cluster random sampling technique as much as 2 classes. The results showed that media interactive learning in Mathematics Capita Selecta course is fine to be implemented. The pre-test showed that students' mathematical creative thinking was low, but the post-test showed that students' mathematical creative thinking performed in an medium level. Students' difficulties in mathematical creative thinking were on the flexibility and orginality indicators. In addition, students feel happy, challenged and motivated to learn in Mathematics Capita Selecta course.

Keywords: *interactive learning media, mathematical creative thinking ability, difficulty thinking, response*

I. INTRODUCTION

Along with the demands of advanced science and technology, there are continuous efforts to improve the quality of education in Indonesia, especially in the field of mathematics education. Require new breakthroughs in curriculum development, human resources, learning and innovation in meeting the educational facilities. In connection with the development of human resources, the lecturer gives a very important role in providing supplies to students as future teachers through lectures. The activity based-learning pedagogy is expected to make students feel responsible for their learning and support their own personal development (Festus, 2013). The use of instructional media is one way to lecturers so that students can understand the concepts that are presented, besides that lectures more interesting and fun so that students can learn more optimally. Various media that can be used in the lecture, including computer-based learning media or Information Technology (IT). One computer-based learning media is an interactive learning media, learning media is more interesting and the material is abstract can be visualized in animation media in accordance with actual conditions in the field, following the development of science and technology so that the motivation of students to learn and build knowledge becomes easier to do (Ali, 2009). One computer-based learning media that are popular today is an interactive medium. The use of interactive media in the learning of mathematics in the classroom is expected to attract interest and motivate students to improve their achievement. According to Kusuma (2009) in general, students have a high curiosity to try something new, including the technology in this decade is loved by teenagers and school children.

Lectures by using interactive learning media is one form of realization of the curriculum in Mathematics Education courses, so that students can learn actively on the Mathematics Capita Selecta course, understand the concepts and be able to develop creative thinking skills. Now, lectures on Mathematics Capita Selecta course already using computer-based learning media but only a powerpoint media that looks less attractive and not interactive, so students seemed less motivated to learn. Currently each class at mathematics education department of Siliwangi University already available means to support computer-based learning. In this condition, the lesson should no longer be a tedious thing, as a few decades ago. Thanks to the development of information technology so rapidly, teaching materials can be presented with sounds and images are dynamic, not boring, as well as solid information. Therefore, the development of Information and Communication Technologies (ICT) based learning is expected to improve the quality of the learning process in the classroom. United Nations Educational Scientific and Cultural Organization (UNESCO, 2002) states that the use of ICT in learning has three objectives: to build a knowledge-based society habits like problem solving, communication skills, ability to find and manage information, turn information into new knowledge and share them with others, and to improve the effectiveness and efficiency of the process learning.

To foster the spirit of learning students, lecturers are required to create learning more interesting and innovative, so as to encourage the learn optimal learning and can develop the capacity to think. Efforts to create exciting and innovative learning and can facilitate develop creative thinking abilities, that is mathematics lectures using interactive learning media. Results of research Kusumah et al (2008, 2009) and Wardani et al (2013) that: a computer-based interactive learning can be presented in an interesting, efficient, and effective interaction patterns tutorials, simulations, or games; increase the ability of reasoning, communication, connection, problem solving, critical thinking, and creative thinking mathematically through learning computer media better than students in the regular classroom learning; implementation of the use of computer media can significantly increase positive attitudes and interests of students in learning mathematics.

Mathematical creative thinking ability toward Guilford model structure of human intelligence which consists of several factors including the operation of divergent product includes fluency, flexibility, and elaboration. Then Torrance (Hudgins et al., 1983) add components originality as a concept fundamental to the components of divergent thinking so that there are four components namely divergent thinking fluency, flexibility, elaboration, and originality. Evans (1991) suggested that components of divergent thinking: the problem of sensitivity is the ability to recognize the existence of a problem or ignore the misleading fact to recognize the real problem; Fluency is the ability to build a lot of ideas are easy; flexibility refers to the ability to build a diverse ideas; Originality is the ability to generate ideas that are unusual or extraordinary, solve problems in ways that are unusual or non-standard. Starko (1995) dan Munandar (2004) suggests that the model structure of the intellect of Guilford is a model of intelligence complex, consisting of 180 components are formed through the combination of content, products, and operations. From the opinions above about divergent thinking of Guilford could conclude that line divergent creativity thinking. Understanding creativity according to Jones (1972) is a combination of flexibility, originality, and sensitivity. Hudgins et al. (1983) provide an understanding of creative thinking is a process that is productive in the sense that the creative thinking to produce a new idea or product.

The purpose of this study to design, develop and implement Adobe flash interactive learning media at Mathematics Capita Selecta Course to explore mathematical creative thinking ability. The purpose of this research:

a. Design, develop and implement interactive learning media at Capita Selecta Mathematics Course.

b. Evaluating the feasibility of interactive learning media based on expert assessment of materials and interactive media and empirical testing.

c. Measuring mathematical creative thinking abilities after using interactive learning media.

II. RESEARCH METHOD

This research is the depelovment with used Research and Depelovment method. The population are all students majoring in mathematics education semester of academic year 2015-2016. Sample used is cluster random sampling technique as much as 2 classes as many as 110 students.

Instruments in this study: open questionnaire, a questionnaire is closed, and questions of mathematical creative thinking ability tests. In developing interactive learning media includes 4 stages: define, design, develop , and implementation. Each stage is explained as follows:

a. Stage define include: study literature, course material identification, analyze the characteristics of students, formulate learning objectives, and designing test questions mathematical creative thinking abilities. At this stage, analyze and identify all the needs required in designing interactive learning media and creative thinking abilities make about mathematics.

b. Stage design includes: the early design of interactive learning media and create questions test ability to think creatively about mathematics as much as 5. At this stage to make a preliminary draft media interactive learning using Adobe Flash program and about the mathematical creative thinking abilities will be tested.
c. Stage develop include: consideration of subject matter experts and media, data analysis and revision, instructional media and about the test results of the revision, the trial is limited to students, data analysis results of limited testing, test empirically, the feasibility of interactive learning media and about the test's ability to think creatively mathematics. At this stage, an evaluation by subject matter experts and media, limited trial against 9 students to see contant validity and face validity, then the empirical testing of students outside a sample of 30 people. The goal is to get advice and feedback to revise media interactive learning and creative thinking abilities about mathematics so that used in this research.
d. Stage Implementation includes: pretest, interactive learning media used in lectures, post-test mathematical creative thinking abilities, distributing questionnaires and interviews to students.

Interactive learning media assessment by experts include indicators: the typeface used, operating instructions, menu navigation, completeness menu display, menu design overall, musical accompaniment, animated illustrations, color harmony, clarity and editorial images, use the button, and interactive. After media interactive learning and creative thinking abilities about mathematics is declared fit for use, and then implemented in the Mathematics Capita Selecta course during one semester. Of each indicator broken down into several aspects of the measure. Scores of interactive learning media assessment rubrics as follows:

Table 1. Rubric Score Assessment Interactive Learning Media

Assessment Criteria	Score
Choose one of assessment criteria	1
Choose two of assessment criteria	2
Choose three of assessment criteria	3
Choose four of assessment criteria	4

Questionnaire for students include positive statement and negative statement. Selection positive statement: strongly agree (5), agree (4), disagree (2), strongly disagree (1) and negative statement: strongly agree (1), agree (2), disagree (4), strongly disagree (5). The ability to think creatively mathematical measure includes five indicators: sensitivity, fluency, flexibility, elaboration, and originality. The following rubric score mathematical creative thinking abilities.

Table 2. Rubric Score Assessment Mathematical Creative Thinking Ability

Number	Indicators	Aspect Measured	Score
1	Sensitivity	Did not answer or answered incorrectly	0
		Detecting deficiency and advantages of the problem but it is not clear	1
		Detecting deficiency and advantages of the problem but there is no mistake	2
		Detecting deficiency and advantages of the problem but not completely	3
		Can detect problems deficiency and advantages with complete and correct	4
2	Fluency	Did not answer or answered incorrectly	0
		Asking just one idea to solve the problem	1
		Propose various ideas solve the problem but there is a mistake	2
		Propose various ideas solve the problem but incomplete	3
		Propose various ideas solve the problem completely and correctly	4
3	Flexibility	Did not answer or answered incorrectly	0
		Solve the problem in only one way, but incomplete	1
		Solve problems with just one complete and correct way	2
		Solve the problem in various ways but incomplete	3
		Solve the problem by various means complete and correct	4

4	Elaboration	Did not answer or answered incorrectly	0
		Completing problem only small fraction	1
		Completing problem but there are still many deficiency	2
		Completing problem but less complete and clear	3
		Completing problems so complete and clear	4
5	Originality	Did not answer or answered incorrectly	0
		Solve problems by using standard formula	1
		Solve the problem in his own way but it is not clear	2
		Solve the problem in his own way but not yet completed	3
		Solve the problem in his own way and true	4

III. Results and Discussion

After identifying the teaching materials and student characteristics, then the early design of interactive learning media which further validated by subject matter experts and media as well as students as users. The following are examples of page views:

Figure 1. Examples of Display Interactive Learning Media

To validate interactive learning media, expert material selected 2 mathematics education lecturers and 2 lecturers computers, both criticism and suggestions, which are summarized as follows:

a. The material was as it should be delivered.
b. There are still some wording should be corrected, should be short, dense, clear and straightforward
c. Operating instructions and the flow should be more clear, systematic, logical and easy to understand; navigation menu is complete.
d. Less harmonious blend of colors should be more contrast, the look of each slide should be more interesting, interactive to be discreet in order to increase interest in learning and curiosity, backround more interesting and not boring, not too loud background music, interesting and appropriate.
e. Operating instructions presented in clear and unambiguous, straightforward, and easy to understand.
f. Should be from menu to menu; from one concept to another concept; from the beginning, middle and end should be interrelated.

Based on input and advice from subject matter experts and interactive learning media, then discuss with programmers to improve software interactive learning media. Once repaired, then validated again by the experts, having been declared feasible, then tested on 30 students from the 7th semester were already studying Mathematics Capita Selecta course but previously tested are limited to 9 students representative of the ability of high, medium, and low to see the face validity and content validity. In general, the students argued against interactive learning software media that is semantically understandable, attractive colors, and display instructions are clear, but the time available is not sufficient. During the trial progresses, researchers observed the activity of students. Based on observations obtained some information: enthusiastic students using interactive learning software media, a discussion with a friend who was beside him, if anyone does not understand to ask. There are constraints experienced, some unresolved issues, but his time is up.

At the end of the trial, distributing questionnaires to students with the aim of asking in response to the use of this interactive learning software media. The response of students to interactive learning media are summarized as follows:

a. The sentences short, dense, and clear; color interesting and not boring; can facilitate self-learning.
b. The procedure of the menu is clear and can be followed, helping to more easily understand the concept, but the time not enough.
c. The problem that is written is clear, but sometimes confused finish so curious to continue to finish.
d. The concept is found through the problem, and completion is full of challenges, linking with the previous concept.
e. Problems and questions provided are varied that no question of easy, moderate and difficult.
f.

Student response to interactive learning media, problems experienced that time provided insufficient, the problems have not been resolved. Based on the results of the validation of the subject matter experts and interactive learning media, limited testing and test empirically the students, as well as the questionnaire to the student can be concluded that interactive learning media is feasible to implement in the lecture Mathematics Capita Selecta course for one semester though in terms of the time provided less adequate. This is because the software media interactive learning, facilitate students find the concept (not notified), lecturer just drive away. If students are having problems, not directly notified but was directed to use the referral question. Thus the automatic will invariably take longer than learning directly notified. Before to the implementation of interactive learning media in lectures, lecture held at the beginning of the pre-test mathematical creative thinking abilities against 110 students obtained a mean 12.21 from maximum score of 20. The results of the pre-test are presented as follows:

Table 3. Pre-test Results of Mathematical Creative Thinking Ability

Number	Criteria	Number of Students	Percentage (%)
1	Very High	2 Person	1.82
2	High	5 Person	4.54
3	Medium	10 Person	9.09
4	Low	93 Person	84.55
Sum		110 Person	100.0

Noting the results table pre-test creative thinking abilities in classical mathematics students are at low criteria, although individually 2 students are at very high qualification and 5 students were in qualifying frequency. Achievement of this kind naturally, because the students have not been trained mathematical creative thinking. At the end of the lectures by using interactive learning media, carried out post-test mathematical creative thinking ability, gained a mean 16.80 results are as follows:

Table 4. Post-test Results of Mathematical Creative Thinking Ability

Number	Criteria	Number of Students	Percentage (%)
1	Very High	9 Person	8.18
2	High	27 Person	24.55
3	Medium	53 Person	48.18
4	Low	21 Person	19.09
Sum		110 Person	100.0

Based on the results of post-test that mathematical creative thinking ability students are at medium levels, meaning the ability to think creatively mathematics of students increased from a low level to medium although the increase is less significant. This is consistent with the results of research Kusuma (2009) and Wardani (2013). Furthermore further explored means on each indicator of the mathematical creative thinking abilities, with the following results:

Table 5. Means Post-test of Mathematical Creative Thinking Abilities
In Every Indicators

Number	Indicators	Means
1	Sensitivity	2.9
2	Fluency	3.3

3	Flexibility	2.3
4	Elaboration	3.1
5	Originality	1.8

Judging from the creative thinking abilities mathematical means every indicator, it can be concluded that the students had difficulty in orginality and flexibility indicators. Based on interviews on students, because thinking about orginality use that is not standard or common or not to use the formula, student difficulties in solving problems in their own way. Similarly, in a matter of flexibility, confused students solve problems in 2 ways. On two indicators, students are not familiar with how to solve the problem alone and in various ways. This is consistent with the results of research Ratnaningsih (2010), the results of research Patmawati dan Ratnaningsih (2015) that students have difficulty in mathematical creative thinking abilities in the indicator flexibility and originality. After the implementation of the post-test, students are given a questionnaire and conducted interviews to determine the interest of students to use interactive learning media in lectures. The results of questionnaires and interviews with media use interactive learning: learning interesting and fun, motivated and enthusiasm for learning, challenging, but the time available is not enough.

IV. CONCLUSION

This research obtained conclusion: based validation experts and media interactive learning materials, empirical testing, and student responses through questionnaires and interviews that the design of interactive learning media worthy implemented at Mathematics Capita Selecta Course. Mathematical creative thinking ability of students increased from a low level into a medium level. Students having difficulty in the ability to think creatively mathematical indicator flexibility and originality. Students get excited and motivated to learn using interactive learning media.

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ME – 66

Improve Analytical Thinking Skill and Mathematical Representation of The Students Through Math Problem Solving

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Abstract**—**Thinking always do by any person or individual, so that thinking is internal and appear in the individual and takes place continuosly. Our expectations as an educator is to make students as thinkers and problem solvers in good way. So we need to increase the skills to think starting from the lowest to high order thinking skills. One of the higher-order thinking skills is a skill to think analytically. Analitycal thinking is subjecting, one subject or problem situation decisions on a rigorous examination of logical step by step. On analytical thought processes can be seen the skills of its mathematical representation, mathematical representation are expressions of mathematical ideas used to show (communicate) work in a certain way (in conventional or unconventional way) as a result of the interpretation of mind. The problem is every student has a different level of thinking, this caused the differences analytical thinking processes in solving mathematical problems. So the necessary alternatives from the activity or environment to improve analytical thinking skills and mathematical representation of student. So that the purpose of this paper is to examine theoretically about solving math problems to improve analytical thinking skills and mathematical representation of students.

Keywords: *analytical thinking skill, mathematical representation, problem solving*

I. INTRODUCTION

Problems in mathematics is to be solved and found the solution. Consciously doing a series of appropriate action to achieve a clear figure, but accomplishment is not directly obtainable. Mathematical thinking skills is a benchmark in solving a problem and to achieve the goals of learning mathematics, especially in higher order thinking skills, one of them is to think analitically. This skills appears when the students solve a given problem, where there is the process of elaborating and understand the relationships that exist within a problem.

Learning math in the classroom should provide enough opportunity for students not only to analyze a problem but also to be able to train and improve the skills of mathematical representation as an important part in the problem solving. The problems are presented with customized content and depth of material on each extent by observing the initial knowledge or prerequisites which students belonged. When students are faced with a situation of mathematical problems in class, they will try to understand the problems and solve them in ways they had known.

Successful problem solving is not possible without the analysis and representation of the appropriate problems. The appropriate analysis and representation of problem is a basic to understand the problem and make a plan to solve the problem. Students who have difficulties in analyzing and represention mathematical problem will have difficulty in doing problem solving. Thus over the importance of problem-solving skills in mathematical learning, then analytical skills and mathematical representation of students needs to be improved because it is the part that can not be separated from the problem solving, it was also functioned in the achievement of the objectives of the learning of mathematics

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II. DISCUSSION

A. Thinking definition

Thinking is a dynamic process, in which individuals acted actively in dealing with abstract things. On the individual thingking process that making the relationship between the object being the principal problems with parts of knowledge already known. Part of the knowledge is everything that's been taken in the form of understanding according to Ismienar [1] think is the development of ideas and concepts in one's self. The development of the idea and the concept is taking place through the process of constructing the relationship between the parts of the information stored in one's self in the form of understanding-understanding. Thinking includes a lot of mental activity. Hudojo [2] states in the process learn math happens thinking processed because is said to be thinking when that persons do mental activity, and those who study mathematics definitely do mental activity. In thinking, people will draw up the relationship between the parts of the information recorded as understanding. From the understanding are drawn conclusions. The skills to think someone influenced by the intelegentsia skills, so there is a link between the intelligentsia with the learning of mathematics. Suryabrata [3] argues that thought is a dynamic process that can be described according to the process or the way. The thought process that substantially there is 3 steps, i.e. formation of the understanding, the formation of opinions and withdrawal of the conclusion. Refer to the above opinion, the process of thinking in this research is a process that begins with a receive data, process and store them in memory and recall of memories at the time needed for further processing.

B. Analytical thinking skills

According to Ismienar [1] think is a mental activity which involves the working of the brain. Although it can not be separated from the activities of the brain, the human mind is more than just a work organ called the brain. The activity of thinking also involves the whole human person and also involve feelings and human will. Think of something means to steer itself on a specified object, realizing actively and host it in mind then insight into the object.

According to Munandar [4] there is a 6 level cognitive domain Bloom thinking skills, respectively from the lowest to the highest, i.e. include knowledge, comprehension, application, analysis, synthesis, and evaluation as shown in the figure below.

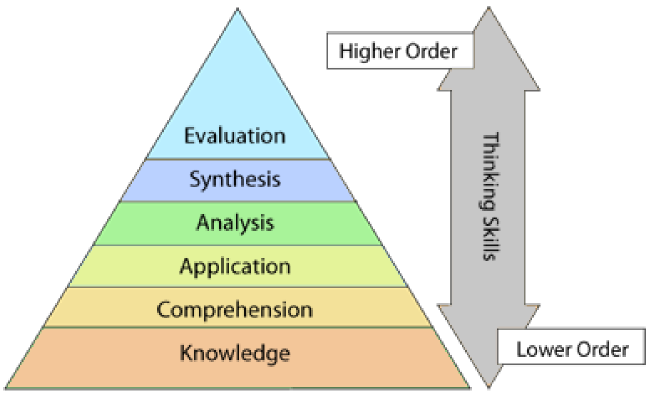

Figure 1. The Skills Of The Cognitive Domain of Bloom

Based on the picture above the skills of analytical thinking capabilities including high level thinking skills. According to Rose and Nicholl [5] "analytical thinking is subjecting one subject or problem situation, decisions on a rigorous examination of step by step logical. Test statements or evidence or proposals in front of objective standards ".

Suherman and Sukjaya [6] States that "the skills of analytical thinking is the skills to specify or to elaborate on an issue (problem) into smaller parts (components) as well as being able to understand the relationships between the parts". It is also reinforced by Bloom who claimed that emphasizes analytical thinking skills at solving the material into more specific parts or small and detect relationships and the parts and the parts were organized. Bloom divide aspects of analysis into three categories, that is: (1) analysis of parts (elements) such as fact example, the element is defined, the arguments, the axiom (assumption), the proposition, hypothesis, and the conclusion; (2) analysis of the relationship (relation) such as linking between the elements of a system (structure) mathematics; (3) analysis of such a system is able to recognize the elements and their relation to the structure of the organized

So it can be concluded that the analytical thought process is the process or its way of thinking analytically, or thought process students to elaborate, detailed, and analyze the information that is used to understand the knowledge by using common sense and logical mind, not based on feelings or guesses.

C. The skills of Mathematical Representation

NCTM [7] include problem solving, reasoning, communication, connection, and representation as a standard process of learning math. This means the representation is one of the standard processes that are important in improving students skills in mathematics.

Alhadad [8] states that the representation is a mathematical expression of the ideas shown students as a model or a replacement of a problem situation that is used to find the solution of a problem is being encountered as a result of the interpretation of his mind. In this case students can try different representation in resolving the problem mathematically.

Pape & Tchoshanov [9] suggest that there are four main ideas in order to conceptualise representation. Firstly, within the domain of mathematics, representation may be a thought of internal-abstraction of mathematical ideas or cognitive schemata that are developed by the learner through experience. Secondly, representation can be explicated as “mental reproduction of a former mental sate”. Thirdly “a structurally equivalent presentation through pictures, symbols and signs” also means to representation. Lastly, it is also known as “something in place of something”

Miura [10] stated that there are two general types of representations that affect children’s understanding of and solution to, mathematics problems: (1) instructional representations (definitions, examples and models) that used by teachers to impart the knowledge to students and (2) cognitive representations that are constructed by the students themselves as they try to make sense of a mathematical concept or attempt to find a solution to a problem.

Lesh, Post and Behr [11] divides the representation used in the mathematics education in five types, include the representation of objects in the real world, a concrete representation, a representation of symbols in arithmetic, representation of spoken language or verbal and representation of a picture or graphic.

As one of the standard process then the NCTM [7] set the standard representation which is expected to be controlled by the students during the learning in school are:

1. Create and use representations to know, mencatatatau record, and communicate mathematical ideas;
2. Select, apply, and perform translation between mathematical representations to solve problems;
3. Use representation to model and interpret phenomena physical, social and mathematical phenomena.

So, it can be concluded that the skills of mathematical representation is students ability to express mathematical ideas are presented as models or replacement of problem situations that are used to find the solution of the problems it faces as a result of the interpretation of his mind. such a problem can be represented through images, words, tables, concrete objects or mathematical symbols

D. Mathematical Problem Solving

Blum & Niss [12] stated that the problem is the situation or circumstances there in contained open-ended questions (open question) are challenging someone intellectually wanted to immediately answer the question with methods/procedures/algorithms and more.

According to Polya [13] definition of problem solving is as a effort seeking a way out of a difficulty, achieving goals that are not immediately achievable. Polya classified problems in mathematics into two groups. The first is the problem of finding something that related to theoretical or practical. Abstract and concrete. The second is the problem related to prove or indicate that a statement is true, false both. Problems associated with finding something more appropriately used on the basic nature of mathematics while problems associated with proved more appropriate use on advanced mathematics.

According to Majid [14] solving problems is a way to give the understanding with students stimulations to observe, examine and think about a problem to further analyse the issue as the effort to solve the problem

According to Polya [13] to make it easier to understand and solve a problem, first is, the problem is organized into simple problems, then analyzed (finding all possible steps will be taken), then the next step is the synthesis of (check the truth of each step is done). At the level of specific problems, the steps in problem solving according to Polya's, that is:

1. *Understand the problem*, the main in this step is to be able to determine what is known and what is asked. To make problem solving process more easily, then the first thing to do is make a note about key points can be either pictures, diagrams, charts or other. If the record key points have been made then the direction of solving the problem it will become clear
2. *Planning solution,* things to do in this step is to find the relationship between the data and the question. The selection of concepts that have been learned. So it can be used to resolve the problems facing it. So the necessary rules in order to make during the process of problem solving takes place. It is certain there will be no need for an alternative that is overlooked.
3. *Implement the plan,* based on the plan, the settlements issue that already planned it. In resolving the problem, each step checked. The step is correct or not.
4. *Check back*, the stage looking back-solving results obtained may be the most important part of the problem solving process. After the completion of the results obtained, to be seen and checked back to make sure all the alternatives are not overlooked for example by way of, looking back at results, looking back on the reasons that have been used, find other results, use the results or the methods used for other issues, interpret back issues, interpret the results, solve new problems, and more

E. Improve Analytical Thinking Skill and Mathematical Representation of The Students Through Math Problem Solving

A problem-solving usually contains a situation which may encourage someone to solving but do not directly know how. If a child is exposed to a mathematical problem and direct the child know how to solve it properly, then the problem can not be classified in the category of problem-solving.

According to Mursel and Nasution [15] learning begins with a problem, then the problem is solved in earnest by analyzing and understanding the relationship between these problems, then that learning is a effort to searching, finding, looking of something, and it will give the pure result if through an experiment.

Solve a problem can be used to stimulate the skills of high order thinking skills in an oriented problems situation. On the learning process in solving a problem, the role of the teacher is presenting problems, ask questions, and facilitate the investigation and dialogue. Problem solving requires students doing the investigation to seek a real solution. They must analyze and define the problems, develop hypotheses, plan, collect and analyze information, do the experiments if needed, and make the inference. After that, students are expected to represent the result of problem solving that has been resolved so that teachers will be able to find out the extent to which students can analyze, and as a proof they had been unable to resolve a problem that has been given.

In solving a problem, more students discuss and cooperate with peers or his group compared to listening to an explanation of the materials from the teacher. Students engage actively in discussion process, exchange of opinions and ideas that they have deals group to find solutions to problems that they discuss.

According to Suhartanto [16] analytical thinking, is to think that using a phase or logically steps and systematically steps. Analytical thinking step is to test a questions or evidence with objective standards. Look beneath the surface until the roots of the problem, make a decision the basis of logic. Through analytical thinking we can elaborate on problems like the tangled threads of outlines

According to Rose and Nicholl [5] analytic thought processes can be reviewed from the process of analytical thinking in solving a problem that is, defining exactly what the real problem, have lots of ideas. Get rid of the most alternative and less efficient throw away those choices that do not meet the criteria that have been set previously, specify option is ideal to look at the best solution that meets the specified criteria, knowing the consequences and impact in resolving the problem.

Mathematical problem solving in the process demands the students to think not only to listen but also to analyze the problem and find a solution to solve the problem, then through discussion with peers or groups making them can exchange opinions or ideas and can represent the completion of mathematically they have, this makes the students gain knowledge or information more and increase the skills to think analytically and mathematical representation of them.

Problem solving systematic in analytical thinking skills and mathematical represestasi as follows:

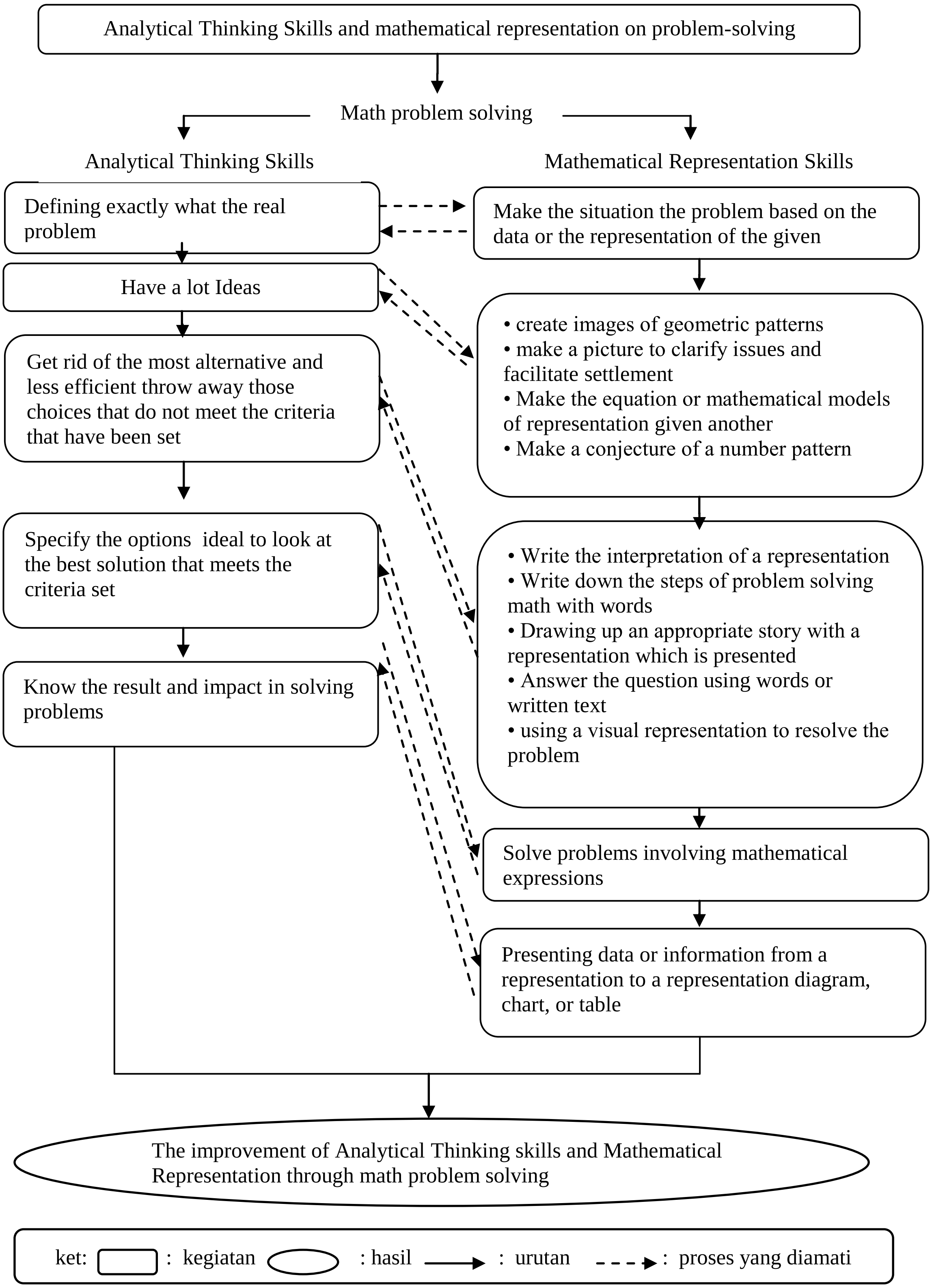

Figure 2. Systematic problem solving in analytical thinking skills and mathematical represestation

III. CONCLUSIONS AND SUGGESTIONS

A. Conclusions

Based on several studies of the above theories can be drawn the conclusion that the math problems have strong linkages in improving analytical thinking skills and mathematical representations. As with the granting of a problem student forced to solve the problem of Connection through problem-solving that students start to get used to think analytically. The skills to analyze a problem indirectly will be increase And then the students representation capabilities will be visible. Because through analytical thinking skills would be the skills to represent something.

B. Suggestions

Expected results of the study in this paper will be a concern for teachers and interested parties to be utilized to enhance analytical thinking skills and mathematical representation of students in learning mathematics. Teachers are expected to foster analytical thinking skills through problem-solving. Solving problems can make the learning meaningful and be processed had more independent in his education, so students themselves will find concepts, and create analytical thinking skills and its mathematical representation increased.

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ME – 67

Development of SMP Student Mathematical Inductive Reasoning and Beliefs With Guided Inquiry Learning

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***Abstract*—**Most of students still believe that the mathematics problems only can be solved by the formula. This belief cause the student mindset cannot be developed. Inductive reasoning ability is very important to be had by everyone, because they always must to take everyday decision inductively. Taking decision on an action to solve everyday problems depend on they subjective knowledge about the object that can be the problem solver. This subjective knowledge are called by beliefs. The Objectives of this research are to knowing about mathematical inductive reasoning ability and beliefs student of Junior High School development with Guided Inquiry Learning. The research methodology used literature study about Guided Inquiry Learning concepts, principles, and procedures so that can developed mathematical inductive reasoning and beliefs. From the results of study found that eight steps, six principles, and six strategies of Guided Inquiry Learning supported the mindset of student inductive reasoning and beliefs development. In Open-Immerse-Explore steps, support students to explore the ideas of the topic based on their knowledge that they have in their scheme. Those steps need student beliefs about mathematics and developed transductive, analogy and generalization abilities. The Identify-Gather-Create steps are the focus guessing, focus inquiring, and concept formation steps from the ideas that converse to a problem which will developed prediction, formation, and generalization abilities. While the Share and Evaluate steps are communication and reflection steps on inquiring results during learning process. Those steps are the peak of learning and can supported a good mathematical beliefs for students as well as developed interpretation abilities.

Keywords: *Guided Inquiry, Inductive Reasoning, Mathematical Beliefs*

I. INTRODUCTION

Mathematics is a universal science that underlying the modern technology (Depdiknas, 2006). Mathematics has a important role in some of discipline science and increase the thinking power of people. Role of mathematics scopes all of people life aspect. Mathematics is way of thinking for people to solving the problem (Copi & Cohen, 1990). Because of that, if one have been solving the problem, whatever problems, so he have been doing mathematics.

Many people who mistake to belief mathematics as knowledge. They believe that mathematics is a calculating science and just learn about formula. Many of them unconscious that doing mathematics activities always have been done in their life day. Mathematics is not only about calculating ability, but reasoning ability too. Where the problem has been solved, there the people have been doing mathematics.

Knuth et al. (2011) in his study of reasoning in young children, stating that secondary schools teenagers is very limited understanding of the general rules of a fact and truth in mathematics. Teenagers more demonstrate the tendency of empirical facts through inductive reasoning rather than deductive reasoning. Yopp (2009) states that a mathematical proof is an expression of deductive reasoning (draw conclusions from the previous statement). However, often inductive reasoning (conclusions drawn on the basis of examples) that help learners to form their deductive argument, or evidence. Inductive arguments are generalizations that have been made on the basis of evidence, in this case, the empirical evidence. Furthermore Michalski (Watters & English, 1995) describes the relationship between inductive reasoning, deductive reasoning, and analogical reasoning. Where the processing of recognize the existence of an analogy between knowledge stored and a real incident intrinsically is inductive reasoning. While the process of making decisions about the common use of analogical mapping is deductive reasoning.

In mathematics, inductive reasoning is the basis for building a concept. Facts mathematically identified through inductive reasoning in order to obtain an initial pattern is used as a conjecture as a first approximation of a mathematical concept. Heit (2007) states there are three (3) study the reasons for the importance of inductive reasoning. First, that inductive reasoning has regarded to opportunities, uncertainties, estimates, and the others where it is most associated with everyday reasoning. Second, that inductive reasoning is a cognitive activity that is very complex and diverse. Inductive reasoning can be assessed by giving a small child a simple question involving a cartoon or give adults some verbal statements varied to determine a conclusion. Third, that inductive reasoning associated with a number of other cognitive activities such as grouping, common ground, the possibility of the decision and conclusion.

Knuth et al. (2011) identify beliefs involvement of students in the process of inductive reasoning. The process of identifying a similar pattern is strongly influenced by the belief of students to conjecture the truth. Where, conjecture is alleged conclusions. Confidence in the truth of conjecture has guided students in identifying a similar pattern on the facts available. The beliefs in mathematical knowledge possessed termed mathematical beliefs. Pehkonen (Kislenko et al, 2007) states that the beliefs an individual's subjective knowledge of a stable, involving feelings or particular attention to the object which the reasons are not always found in an objective consideration. Beliefs recognize the existence of a very close relationship between thinking and feeling. It cannot be avoided, because on the one hand beliefs is part of a person's knowledge is highly subjective and on the other side of the conception of beliefs and feelings often have in common (Kartini, 2011; Isharyadi, 2015).

According to the language, the Oxford dictionary, beliefs defined as the feeling that something is true or something accepted as true. Thus, the sense beliefs include two things, namely, the feeling (feel) and truth (true). Still cannot be determined precisely how the definition of beliefs. However, in everyday terms, beliefs often interpreted as an attitude, disposition, opinion, perception, philosophy, and values (and Forgasz Leder, 2002). Given these concepts are difficult to observe and closely interconnected, it is difficult to find a precise definition of beliefs.

To encourage the activity of inductive reasoning and increase students' mathematical beliefs in doing math, we need a model of learning that gives students the opportunity to be directly involved in investigations of mathematical concepts. With this investigation activity, the students will be directly involved in the process of understanding the mathematical knowledge and improve students' mathematical beliefs.

Kuhn et al. (2000) defines the inquiry learning as an educational activity in which students individually and in groups to investigate a set of phenomena (virtual or real) and draw conclusions based on the phenomenon. In inquiry learning, student do inductive reasoning, where the conclusions obtained in the learning process is the result of an analysis of the facts observed by the knowledge of the students. This may indirectly increase the ability of inductive reasoning and mathematical beliefs of students.

Kuhlthau et al. (2007: 2) states that the inquiry is an approach to learning in which students find and use various sources of information and ideas to improve their understanding of the problem, topic or issue. Inquiry is not just how to answer questions or get the right answer, but the inquiry to support the process of investigation (investigation), exploration (exploration), search (search), attempts (quest), research (research), pursuit (pursuit) and learning (study). Colburn (2000: 42) describes the Inquiry as the creation or management of a classroom where students are involved in basic problems of open (open-ended), centered on the student, and the practical activities of students. Although the student-centered and emphasizes the open-ended problems, but the inquiry learning does not mean students without guidance, inquiry forms provide intervention to students in the form of scaffolding.

However, the Inquiry learning students often experience frustration at the exploratory stage (Kuhlthau et al., 2007). The frustration caused by the inability of students in finding a focus on the ideas expected in the learning objectives. Therefore we need guidance in investigating and identifying the focus of learning.

Inquiry guided by teachers to enable students gain a depth of understanding and personal perspective through a variety of sources of information is called Guided Inquiry. Guided Inquiry allows students to determine the importance of establishing a focus, make decisions, manage investigations, interpreting facts and organize ideas and share their learning with others. In the model of Guided Inquiry Learning, teachers and students play an important role in asking questions, developing answers, structuring materials and cases (Bilgin, 2009), and jointly create learning materials more meaningful and also inspire intellectual curiosity (Gialamas et al, 2000).

II. MATHEMATICAL INDUCTIVE REASONING

Mathematical reasoning is usually divided into two types, namely deductive and inductive reasoning (Smith et al., 1992; Watters & English, 1995; Klauer et al., 2002; Sumarmo, 2010). Shye (Klauer et al., 2002) states that inductive reasoning means making the rule essentially, while deductive reasoning applying the rules. Deductive reasoning is an activity mathematically to draw conclusions on a specific facts according to the general rules, whereas inductive reasoning is the opposite, namely to draw general conclusions according to the specific facts (Polya, 1957; Copi & Cohen, 1990; Watters & English, 1995; Sumarmo, 2010; Lassiter & Goodman, 2014; Molnar et al., 2013; Hayes et al., 2013; Yopp, 2009).

According to Molnar et al. (2013), described as a generalization inductive reasoning to an observation and experience to find a common conclusion or making a broad rule. Inductive reasoning involves the expansion of knowledge of which is known to be examples of new ones (Hayes et al., 2013), involves the facts are there to make the same conclusion (likely) and reasonable (plausible) but not necessarily true (Lassiter & Goodman , 2014), combines observations and explanations to deduce a rule of something special into something common (Mantere & Ketokivi, 2013). Inductive reasoning is the formation of concepts, generalizations facts, and estimate the sample obtained from specific statements into something more general.

Klauer (De Koning et al, 2002; Hamers et al., 1998) defines the inductive reasoning as an activity to compare systematically and analytically that aims to find order in the chaos that is real and chaos in the real regularity. With inductive reasoning, one can find order, rules, generalizations, and also the opposite can find irregularities (Klauer et al., 2002). Inductive reasoning is an important strategy in problem solving (Tomic, 1995; Nisbett et al, 1983). Inductive reasoning is the process whereby a person to generalize based on a number of examples, facts or observations were limited to finding an idea that can be implemented thoroughly. Inductive reasoning allows one to make predictions on a possible new ones based on existing knowledge to anticipate solutions to problems (Tomic, 1995; Hayes et al., 2010).

Experts have outlined some of the activities of inductive reasoning. Nisbett et al (1983) suggest that the formation of the concept (concept formation), a generalization of the facts (generalization from instances), and the estimate (prediction) are all examples of activities of inductive reasoning. Csapo (1997) revealed that the majority of inductive reasoning includes the analogies (analogy), completing the pattern or series (series completions), and create a classification (classifications). Haverty et al. (2000) states that there are three fundamental activity in the inductive reasoning of data collection (Data Gathering), discovery of patterns (Pattern Finding), and the formulation of hypotheses (Hypothesis Generation). Klauer (De Koning et al, 2002; Molnar, 2011; Molnar et al., 2013) divides the task characteristics of an inductive argument into three classifications: (1) the similarity (similarity) includes recognize similarities in the nature or generalization (generalization) and recognize the similarity relationships (recognizing relationship); (2) the inequality (dissimilarity) includes distinguishing characteristics or discrimination (discrimination) and distinguish the relationship (differentiating relationship), and (3) a combination of both covers the classification of cross (cross-classification) and the build system (system construction). Sumarmo (2010) reveals more about the operational activities of inductive reasoning which includes six (6) activities, among others, (1) Transductive: draw conclusions from one case or the specific nature of which one is applied to the other special cases; (2) Analogy: drawing conclusions based on the similarity of data or processes; (3) Generalization: general conclusion is based on a number of the observed data; (4) Prediction: predict the answers, solutions or trends; (5) Formation: using patterns of relationships to analyze the situation and draw up a conjecture; and (6) Interpretation: explain to the model, the facts, nature, relationships, or the existing pattern.

III. MATHEMATICAL BELIEFS

Researchers felt difficult to separating the concept of attitudes and beliefs. Kartini (2011) states that a person's beliefs is the attitude of an object as a result of deep involvement and introduction of the object. Kloosterman (2002) looked at the existence of a direct relation between effort and beliefs. Where, beliefs have been expressed as the feeling and the knowledge that students bring the influence to their efforts in their act. Understanding fairly easy to understand and widely expressed by Rokeach (Kislenko et al. 2005) where beliefs are simple statements, whether consciously or not, based on the conclusions of the words or actions that can begin with the phrase "I believe that ...". To see one's beliefs, can be seen from a simple statement. Because, a simple statement is a reflection of the attitudes and knowledge as a result of its beliefs.

Epistemologically (Op't Eynde et al, 2002), the differences of knowledge and beliefs are that beliefs have been formed from individual aspects while knowledge formed from the social aspect. Beliefs are believed to focus on something and deny the fact that other people agree or not. Furthermore, Thompson and Scheffler (Op't Eynde et al, 2002) suggests knowledge is an aspect that demands a correct conditions, while beliefs are not bound by elements of accuracy. So that what is disclosed is based on beliefs can not be used as a reference the truth.

Developments in beliefs form a system of beliefs. Beliefs systems are dynamic and will be restructured if there is an evaluation of others to one's beliefs. The same thing happens when a change in a person's cognitive structure. Scheme someone will change as we get experience. Thus, beliefs also will change beliefs with increasing experience as one component in the cognitive element. The same thing was disclosed by Muis & Duffy (2013) that a person's beliefs evolved through the dynamic interaction between the individual and the environment to form a belief in a sustainable manner.

Based on these opinions above it can be concluded that students' beliefs strongly influenced by environmental conditions and the school where the student resides. Like in the mathematics classes. Then the conditions and environment in the mathematics classroom will greatly influence the beliefs of students towards mathematics. Experience during the learning of mathematics will form correct mathematical beliefs in students.

Op't Eynde et al (2002) found that students' beliefs about mathematics are subjective view clearly and completely student who is regarded as a truth that affects the way they solve problems and learn mathematics.

Beliefs about knowledge of a person referred to as epistemic beliefs (Corkin et al, 2015). Epistemic beliefs include three (3) things: (1) a person's beliefs about where knowledge comes, (2) the core material or subject knowledge, and (3) how did one known the truth of knowledge. Based on that, if viewed as a mathematical science, the students 'mathematical beliefs is the students' beliefs about mathematics that includes the origins of mathematics, the core of mathematics, and how to learn mathematics.

Muis & Duffy (2013) epistemic beliefs more clearly divide students into four (4) dimensions that can be developed over time and through experience in education, namely (1) certainty/simplicity; (2) justification of beliefs; (3) source of knowledge; and (4) the attainability of truth.

Dimensions certainty / simplicity is the individual's beliefs about the nature of a knowledge. In mathematics education, then this dimension expresses the beliefs of students to the nature of mathematics. Components of certainty on these dimensions reflect whether students saw math as knowledge of both fixed and variable. While component of simplicity reflect students' beliefs towards mathematics as simple or complex knowledge.

Dimensions justification of beliefs about students' beliefs that reflect the true knowledge obtained based on expert opinion or the opinion of students through direct experience. In mathematics education, the dimension is revealed about the students' beliefs about how to learn is how to obtain evidence of mathematical truths. This dimension reveals whether mathematical truth is based on the concept of the experts or the student's own direct observations.

Dimension source of knowledge reflects students' beliefs that knowledge comes from outside himself and sourced in others such as teachers, other experts or can be derived from the others with him in which knowledge can be created personally. In mathematics education reveals the dimension of students' beliefs about mathematics teaching strategies. This dimension reveals that the mathematical knowledge obtained by the students is the result of discussions with other people instead of himself.

Dimensions attainability of truth reflects a person's beliefs are the truth can finally be achieved. In mathematics education then this dimension to the efforts of students expressed confidence in solving mathematical problems. This dimension also encompasses beliefs of students towards mathematics problems, that all problems can be solved in mathematics.

IV. GUIDED INQUIRY LEARNING

Kuhlthau et al. (2007: 17) revealed that there are problems that occur in students during the initial Inquiry, which is in the process of identifying problems and developing hypotheses. In such a step is necessary exploration (exploration) and the formulation of hypotheses (formulation) which requires students to conduct an investigation, raises key questions, the issue of the right or the key issues to be searched information on the data collection phase.

This stage often causes most students find it difficult and frustrating in the learning process. This stage is crucial because it determines the success of learning. Uncertainty is the beginning of learning (Kuhlthau et al., 2007). Initial information students need to keep the quality of learning outcomes through problems instead of reducing it. Students need to be made aware of their problems and learn to work through the ideas that led them to the understanding and reduce confusion. Teachers' guidance in the form of initial information is then that creates learning models Guided Inquiry.

According Kuhlthau et al (2007: 1) Guided Inquiry is an integral part of the Inquiry planned and guided by the teacher in order to provide a way for students to gain a deep understanding of the concept of learning materials and information. There are 6 (six) counseling strategies undertaken in Guided Inquiry among others (1) Collaborate by working with others, (2) Converse are talking about focusing ideas for clarity and follow-up question, (3) Continue namely the development of understanding all the time, (4) choose which choose what is in demand and relevant, (5) chart that depicts the idea of using images, timelines and graphs, (6) Compose ie write whatever occurs during learning.

There are six principles that underlie learning Guided Inquiry (Kuhlthau et al, 2007: 24), namely: (1) students learn to engage actively and reflect on the experience; (2) students learn to build on what they already know; (3) students develop higher-order thinking through guidance at critical points in the learning process; (4) students have ways and different learning styles; (5) students learn through social interaction with others; and (6) students learn through instruction and experience according to their cognitive.

Steps Guided Inquiry learning by Kuhlthau et al (2012) consists of 8 stages, namely the Open, Immerse, Explore, Identify, Gather, Create, Share, and Evaluate.

The first stage is Open (Orientation). Open an interesting stage of the students' attention to the beginning of the investigation process. This stage is very important to set the rhythm / rules and directions of investigation. The first team learning has decided learning objectives, then makes strong apperceptions and introduces a general topic that involves all students. The main objective of this phase is to open students' minds and stimulate curiosity and inspire them to be motivated in pursuit of the investigation. Apperception designed to spark conversation and stimulate students to think about the content of the entire investigation and connect with what they already know from personal experience and knowledge.

The second stage is Immerse (Introduction to the problem). Immerse the stage of building the knowledge base of students together through the experience embedded in students' thinking. Team learning makes the design ways to engage students so immersed in the whole idea of learning materials by reading books, stories or articles, watch videos, visit museums, historic sites and pay attention to the experts. The main objective of this phase is to guide students to connect with the content as a whole and to discover interesting ideas that they want to explore further. When they build a knowledge base together, each student find ideas that are important to him and worth reading further to be used as a probe.

The third stage is the Explore (Browsing issue). Explore a variety of sources of information search phase to explore interesting ideas obtained in phase Immerse. Teacher guides students to apply reading strategies, view and scan multiple sources. Teacher led them keep an open mind and reflect new information that they face and begin to find a question that seems very important to them. Guiding students through this stage will bring them to form a meaningful question.

The fourth stage is the Identify (Invention focus). Identify the pause stage in the investigation process to develop meaningful questions and forming focus. The main objective of this phase is to build a question of ideas that are interesting, pressing problems, and bring up the theme.

The fifth stage is a Gather (Research focus). Gather is the stage of collecting information vital to the question of focus. Team learning guide students discover, evaluate, and use information that leads to deeper learning.

The sixth stage is the Create (Formation of concept). Create a step to integrate the ideas to the understanding of the concept of a stronger and deeper. Team learning guide students to explore the facts and make a simple statement to summarize, interpret and extend the meaning of what they had found and created a way to share what they have learned.

The seventh stage is Share (Share the concept). Share a peak stage of the investigation process when students share the products they have created and show what they have learned. They now have the opportunity and responsibility to share insights with their peers and communicate to others. An important component of Guided Inquiry is a collaborative learning happens when students share what they have learned in the investigation process.

The eighth stage is the Evaluate (self-assessment). Evaluate the closing stages of the investigation process and an integral part of the Guided Inquiry. This stage also guides students to reflect on the self-assessment of the learning material and their progress through the investigation process. During the process of reflection will refresh their minds and strengthen learning materials and build good habits in learning.

So, based on the description above, Learning Guided Inquiry as defined in this study is a model learning Inquiry planned and guided by the teacher in order to provide a way for students to gain a deep understanding of the concept of learning materials and information with 8 lesson, namely the Open, Immerse , Explore, Identify, Gather, Create, Share, and Evaluate.

V. DISCUSSION

Through guidance at critical points in the learning process, Guided Inquiry support high-level thought processes such as inductive reasoning is maintained. Guidance will rekindle students' beliefs (beliefs) to continue to investigate and discover the ideas embedded in students.

Although students learn through social interaction with others but Guided Inquiry recognizes that students have ways and different learning styles. There are no way and learning styles better than others. Student is a unique person. Nothing is better than the other, they are together have a way and style to enhance its capabilities. This belief has been instilled in students. It is strongly associated with beliefs, where students have to trust and believe with the knowledge and experience that already exists within them. Each student is accommodated to learn through instruction and experience according to their cognitive.

At this stage of the Open, teachers provide students the essential information needed in the investigation process. Apperception will increase students' beliefs about the nature of mathematical certainty that dimension / simplicity. A discussion of prior knowledge, will encourage students to develop the ability to draw conclusions on a specific case. Indirectly this will enhance the ability transductive.

Immerse At this stage, the teacher presents a problem and guide the students to describe the problem. Facts already known to students of the problem will increase students' beliefs dimensional nature of mathematical problems, namely the attainability of truth. Formulation of the problem will develop students' skills in connecting facts with the information that is already known. It is specifically an analogy skill.

At this stage of Explore, teachers guide students to find information about the existing problems. Information can be obtained from the Internet or reading books. Then students make notes so finding a focus problem that should be investigated. Focus invention is to develop students' beliefs about how knowledge is acquired and developed the ability to draw conclusions from the data similarity is the ability of generalization.

In the Identify phase, the students with the guidance of teachers make decisions about the focus of the problems encountered. This phase emphasizes to students that the knowledge acquired together through discussion. In particular will bring students' beliefs about the way teachers teach. The focus of the problem is the claim of a major problem. It will develop the predictive ability of students to solve a problem.

Gather At this stage, the students prove focusing problems with the experiments they do themselves. Thus, it will develop a belief that the knowledge gained through experience alone. Records of the results of the experiment the students will also improve the ability of preparing a conjecture through patterns to result from the data obtained. In particular this is the ability of the formation.

In the Create phase, students make conclusions based on the data obtained in step gather and make products for presentation discussed with friends the other. This will develop students' beliefs about the true nature of mathematics, that mathematics is not just about counting, but also to reason. Drawing conclusions based on the similarity of data in particular will increase the generalization ability.

Share on stage, students discuss their findings with another friend. This will increase confidence that knowledge does not come from myself, but from the results of cooperation and discussion. At this stage students will explain the study results, it will increase the ability of the interpretation of the facts obtained from the experiments.

Evaluate At this stage, the teacher gives a reflection exercises as a result of the investigation the students. This will increase the belief that all problems can be solved in mathematics. The evaluation process will also improve the ability of students in the interpretation of the facts that exist in the given problem.

In general, the relationship between guided inquiry learning, inductive reasoning and mathematical beliefs can be described as follows:

Guided Inquiry Stages		Guided Stratgies and Principles		Mathematical Skills Development: Beliefs		Mathematical Skills Development: Inductive Reasoning
Open	→	Guided Inquiry Principles: • Active reflection • Based on scheme • Guided on critical spot • Difference learning style • Collaborative learning • Based on cognitive level. Guided Strategies: • Collaborate • Converse • Continue • Choose • Chart • Compose	→	certainty/simplicity	→	Transductive
Immerse	→		→	attainability of truth	→	Analogy
Explore	→		→	justification of beliefs	→	Generalization
Identify	→		→	source of knowledge	→	Prediction
Gather	→		→	justification of beliefs	→	Formation
Create	→		→	certainty/simplicity	→	Generalization
Share	→		→	source of knowledge	→	Interpretation
Evaluate	→		→	attainability of truth	→	Interpretation

FIGURE 1. ASSOCIATION BETWEEN GUIDED INQUIRY LEARNING, MATHEMATICAL INDUCTIVE REASONING AND BELIEFS

VI. CONCLUSION

The principles and stages of Guided Inquiry learning supports upgrading of mathematical inductive reasoning and beliefs. Guided Inquiry Learning support students to engage actively and reflect on the experience and build on what they already know. This is an inductive thinking process. Where students should be actively to involved in real experiences and build the concept through the transductive, analogy, formation, generalization, interpretation and prediction skills. By building concept which based on what students already know, it motivates students to develop mathematical beliefs, because they basically have experiences in mathematics. The experiences they are used to solve mathematical problems.

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Van Hiele Theory to Improve Higher Order Thinking Skills in Geometry

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Abstract—Nowadays, education requires students to have conceptual knowledge and skills in thinking and understanding. Higher order thinking skills (HOTS) is one of skills that required in improving skills of thinking process. HOTS are one of skills that students required to face competition globally. Students' understanding in geometry subjects also should be improved. One theory of learning in geometry which fit to improve conceptual knowledge and higher order thinking skills is a learning theory Van Hiele. Learning theory Van Hiele can build understanding of the concept of geometry includes four levels, namely level 0 (visualization), level 1 (analyze), level 2 (abstraction), level 3 (deductive) through five stages: stage 1 (Information), stage 2 (guided orientation), stages 3 (explicitation), stage 4 (free orientation), and stage 5 (integration). Learning theory Van Hiele can improve student's HOTS because: (a) the learning process by using learning theory van hiele can empower students to construct knowledge; (b) effectively used in learning individualy or in groups; (c) as a variation in learning activities to improve student's skills; (d) as a learning process to manage student's conceptual of geometry.

Keywords: *Van Hiele Theory, higher order thinking skills, geometry*

I. INTRODUCTION

Education is basically prepared to equip students to be able to think in a rational, critical, creative, logical, and higher level thinking and systematic thinking is correct in dealing with the problems of life. One of the goals of education is to help someone in studying various things not knowing that they were able to cultivate the talent and potential that they have. With the education of students expected to meet the needs for today and the needs of students to come. The needs of students who will come is that students have the skills to think critically and creatively in society that will be able to compete with other nations and excel in the field of Science and Technology (Science and Technology).

Mathematics is one of the basic science that is taught in every level of education, from primary education up to college. Mathematics plays an important role in educating learners because it can develop logical thinking skills, analytical, systematic, critical, creative and ability to cooperate. This is consistent with the Content Standards in Government Regulation No. 22 of 2006 which states that "mathematics is a need for learners to equip learners with the ability of logical, analytical, systematic, critical, creative, and ability to cooperate.

In the 2013 curriculum development, learning mathematics includes critical thinking skills and creative thinking that is the purpose of learning. Critical thinking is one of the educational goals that require exercises to improve the ability to think critically and make decisions about what to do and believed. According to Dewey (Fisher, 2008: 2) states that critical thinking is to consider actively, constantly, and meticulous about a belief or form of knowledge in light of the reasons which support it and the conclusions that become trends. Nurhadi and Senduk (2009: 86) states that the purpose of critical thinking is to create a spirit of critical thinking that encourages students to question what they hear and examine their own mind to ensure there is no logic to inconsistent or erroneous.

Creative thinking is defined by Isaksen et al (Grieshober, 2004) as the construction process ideas that emphasizes the aspects of fluency, flexibility, novelty, and of detail. According to McGregor (Ali Mahmudi, 2010: 2) creative thinking is the thinking that led to the acquisition of new insights, new approaches, new perspective, or a new way of understanding things. Critical thinking is supported by the problems that challenge. According to Martin (Ali Mahmudi, 2010: 2) three aspects of creative thinking ability is productivity, originality, and flexibility.

Both of these skills, namely critical thinking and creative thinking, including in high-level thinking skills criteria (higher order thinking skills). Higher order thinking skills (HOTS) is a thought process that consists of components of critical thinking and creative thinking (Conklin, 2012: 4). Higher order thinking skills are very important in the learning developed especially for the learning of mathematics in solving unusual problems require both these capabilities, the ability to think critically and creatively. In helping students create their own knowledge, the main task of the teacher is to create activities or environments that allow students to engage in higher-level thinking activities. Brookhart (2010: 6) mentions the learning objectives to develop HOTS is to equip students skilled in giving reasons, describe and make a decision. A crucial aspect of higher order thinking skills to support students to think logically, creative, critical, and metacognitive, but it also trains students to solve problems that have not been met.

Low ability students' higher order thinking in mathematics in Indonesia indicated from the data survey conducted by TIMSS in 2011 are reviewed in three aspects, namely: knowledge, application and reasoning as in Table 1 below (Mullis, Martin, Foy, & Arora, 2011: 150).

Tabel 1. Average Score Indonesia Based on TIMSS data in 2011

No	Capability category	Average	Maximum Score	Minimum score
38	*Knowing*	378	616	331
	Applying	384	617	316
	Reasoning	388	612	322

The data above show that cognitive achievement in mathematics which measures three aspects of the ability is still in the low category. This is because the category of questions that tested a new thing for the students and not because of the inability of students to solve problems given.

Fauzan research results (2002: 30) shows that the understanding of most students at the junior level of the concepts of geometry (eg, a square, a parallelogram, and triangles) is still low. They can not recognize these objects even though they have studied since the base rate. Not much different from the results of the TIMSS 2011 on domain knowledge, the analysis of the absorption of students based on the results of the National Examination (UN) on the geometry also show that such knowledge need attention.

Based on these facts, we conclude that there is still a capability that needs to be improved. One of them is the high level of students' thinking skills that include critical thinking skills and creative thinking ability Teachers doing activities during the learning process too monotonous and still traditional, which is centered on the teacher. This makes the interest of students to the learning process tends to be boring. In addition, the difficulty of learning the math does not fit the model applied learning in the classroom so that students do not manage to understand the material when studying mathematics.

Van Hiele learning theory is a theory in the teaching of geometry, which outlines the stages of mental development of children in geometry. According to this theory, there are three main elements in the teaching of geometry that time, teaching materials and teaching methods are applied. If all of them arranged in an integrated manner it will be able to enhance the thinking ability of children to a higher level.

Van Hiele theory states that there are five stages of a child's learning in learning geometry, namely the introduction stage, the stage of the analysis, the sorting stage, the stage of deduction, and phase accuracy. Based on the understanding of the geometry stage explained that students can not reach a stage of thinking without going through the previous stage. Not forgetting inherent in Van Hiele theory that, in understanding the geometry, one must go through the level sequentially. This is referred to as the ordered nature of these levels. Van Hiele theory also has three unique characteristics: elegance, comprehensiveness, and wide applicability. Elegance means that the theory using a simple structure that is illustrated with concise statements with great effect. For example, the same principles are used to move from level 1 to level 2 from level 2 to level 3 and so shows a graceful shape. Then the simplicity of its structure, becomes evident when one knows that the knowledge-knowledge at level 1 is the foundation for the properties at level 2, which is then sequenced at Level 3, the order of the main prerequisite for understanding the system of mathematics at level 4, one of the objects the compared at level 5.

Based on the above description shows the importance of higher order thinking skills of students in learning math skills. In addition, in the learning of mathematics is still very rare learning device specially designed to develop students' higher order thinking.

Based on the background above, some problems can be formulated as follows:

1. How will learning geometry-based SMP by using Van Hiele theory which is oriented in Higher Order Thinking Skills (HOTS)?
2. What steps learning theory by using Van Hiele which is oriented in Higher Order Thinking Skills (HOTS)?

II. EXPLANATION

Learning in Indonesia has been more centered on the teacher (teacher centered) and still use the approach / methods vary. Therefore, students tend to be less active in the learning process and learners are also not optimally solving mathematical problems and not meet aspects of high-level thinking. In mathematics higher level thinking skills are very important, because it is one of the goals of mathematics learning. It takes a learning device that can make learners active and have a high level thinking skills through the activities contained in the learning device.

Had a lot of learning activities that involve a variety of activities learners will make the learning of mathematics more meaningful. With these activities will help learners to reflect on learning experiences and create relationships, meaning, purpose and value of the experience. Thereby increasing the ability of high-level thinking learners. Hence the need for learning innovation accordance with the conditions of learners. Learning should be constructed so that it can spur students to be active and interested in a variety of math problems.

In accordance with the above description, to develop learning that can engage learners in learning activities and improve high-level thinking skills for students requires a suitable learning theory will be applied to the learners. One theory of learning which to improve high-level thinking skills in geometry is studied Van Hiele theory.

In studying Van Hiele theory there are a wide variety of student activities that can be implemented in the study of mathematics, especially geometry learning that aims to enrich, deepen and expand the capabilities of high-level thinking learners.

Mathematics learning by using learning implement learning activities in the Van Hiele theory is a study that is expected to enhance the ability of higher level thinking learners and can involve a wide variety of student activity in the learning process. Thus, in the end will create a more active learning and can increase high-level thinking skills for students.

Nitko and Brookhart (2011: 223) states that "a basic rule of assessment of higher order thinking skills is to use tasks that require the use of knowledge and skills in new or novel situations". This means that the fundamental rule in measuring students' higher order thinking skills are premises give tasks using knowledge and skills with new situation. Brookhart (2010: 17) state that the general principle in assessing higher order thinking skills that consists of six aspects. The principle is as follows.

1. Define clearly and precisely what is being assessed
2. Items designed tests require students to use the knowledge and skills
3. Determine what will be taken as a result extent to which students have demonstrated knowledge and skills.
4. Provide something for students to think, usually in the form of an introductory text, visual, scenario, material resources, or a problem of some sort.
5. Using a new material for students.
6. Distinguish between the level of difficulty of thinking a lower level and higher level thinking, also control for each separately.

Assessment skills higher order thinking skills, according to Collins (2010) is an assessment rubric in the form of higher order thinking skills are developed locally rubric used to evaluate students' thinking skills in areas such as: application, analysis, evaluation, and creative. In addition, according to Thompson (2012) to measure the skills of higher order thinking skills for coverage of a class or ratings scale is based on the following three aspects:

1. Considering the sensitivity of the students in deciding whether the test items include low order thinking (LOT) or higher order thinking (HOT);
2. Using the special mathematics assessment framework with various categories of ratings;

3. Item test higher order thinking (HOT) is not confusing and used in real-world contexts (daily activity).

Furthermore, in compiling a matter of higher order thinking skills (HOTS) in this study is guided proposed by Principle NCTM Standards for Teaching Mathematics (2000) as follows.

(1) Questions that help students work together to make sense of mathematics

(2) Questions that help students Rely more on themselves to Determine Whether something is mathematically correct

(3) Questions that help students learn to reason mathematically

(4) Questions that help students learn to conjecture, invent, and solve problems

(5) Questions that help students to connect mathematics, its ideas, and its applications.

This means that in formulating the question higher order thinking skills then: (1) questions to help students use reasoning to understand the math, (2) questions that help students more reliant on determining whether something completely automatically, (3) questions that help learning to mathematics reason, (4) questions that can help students learn to suspect, discovery, and solve problems, (5) questions that help students to connect HOTS with mathematics, ideas, and practices. Furthermore, Khan & Imanullah (2011) states that most of the questions that the low order includes knowledge, understanding, and applications.

Based on expert opinions and theories that have been described above it can be concluded higher order thinking assessment indicators used in this study guided by indicators blooms taxonomy revision by Anderson & Krathwohl (2001). Indicators are assessed adapted to the definition of higher order thinking skills (HOTS), namely: (1) critical thinking skills and (2) upon ability to think creatively.

Aspects of both the ability of higher order thinking skills at the top, ie critical thinking skills and creative thinking, described as follows.

1. Critical Thinking

Ennis (Costa, 1991: 80) states that "critical thinking is reasonable, reflective thinking is focused on Deciding what to believe or do". It means that critical thinking is thinking that is reasonable, reflective thinking that is focused on deciding what to believe or do. Aspects of critical thinking by Ennis (Costa, 1991: 80), namely: (1) clarification of the base, (2) support base, (3) In conclusion, (4) further clarification, (5) the strategy and tactics. The aspects above are used by researchers as a reference in the preparation of a matter of critical thinking.

2. Creative Thinking

Brookhart (2011: 124-125) states that creativity is defined as putting something in a new way, observing the other things were missing, to build something new, unusual or unconventional use imagery to keep working to make things interesting, and the like. From the above definition, it can be concluded assesing aspects of creative thinking, namely: (1) reasons, (2) create, (3) evaluate.

Higher Order Thinking Skills in Mathematics Learning in mathematics learning is one of the goals to be achieved are higher order thinking skills (HOTS). This requires skilled in mathematics teachers to provide questions that measure these aspects so that students become accustomed to work on the problems which measure skills HOTS.

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The Implementation Of Contextual Teaching And Learning In Differential Equations

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***Abstract*—**This research aims to describe: 1) the implementation of Contextual Teaching and Learning in Differential Equations ,2) the students response after implementation of Contextual Teaching and Learning in Differential Equations. This research was a quantitative descriptive research with 34 students of Mathematics Education Department, Universitas Muhammadiyah Surakarta who enrolled Differential Equations as participants. The data collected through observation, field notes, questioner, and documentation. The technique of data analysis were the flow-method that consist of data reduction, data display and verification. The results of this research were: 1) the Contextual Teaching and Learning in Differential Equations was implemented using discovery learning process with seventh phases, i.e: stimulation (questioning), problem oriented (learning community and questioning), data collection (learning community, questioning and constructivism), data processing (learning community, questioning, constructivism and inquiring), verification (learning community, questioning, and modelling), and generalization (constructivism), 2) the students response after implementation of Contextual Teaching and Learning in Differential Equations was very good. It was demonstrated by the average score of the students response.

Keywords: *implementation, contextual teaching and learning, differential equations, students response*

I. INTRODUCTION

Diferential equations is one of the courses that may be used in various areas of our life. Not only in mathematics, Differential Equations also can be applied in other areas such as physics, chemistry, biology, economic techniques, psychology etc. Differential Equations used to formulate the real-world problems in the mathematical form. In other words, Differential Equations is the mathematical modeling of real problems or issues in our daily life. However, the teaching and learning of Differential Equations still priority to the techniques or procedures only , it has not be frequently associated with the real life.

Contextual teaching and learning is one of the teaching approached used in the daily problems or issues around the students as an object lesson. Johnson [2] stated that contextual teaching and learning encourage students to see the meaning of academic theories that they learn to connect the academic subjects with the context in their daily life, namely with the context of the personal circumstances, social and their culture. Contextual learning is based on the premise that a meaning will appear if there is a relationship between the content and context. The more links found students in a context, the more meaning for the students. More and more students were able to link the learning materials to the specific context, the more meaning the student will get in this lesson. Meanwhile, Hamruni [1] states that contextual learning is a process of learning that emphasizes the involvement of students in order to find the relationship between the material learned to real life situations. Contextual learning, students are fully engaged in the learning process. Students not only learn by listening and recording, but the learning experience directly in real situations that are around. Through the process of direct experience, students will experience the development as a whole, not only cognitive, but also psychomotor and affective aspects..

Contextual teaching and learning has characteristics as explained by Muslich [6]: (1) Learning in real life settings, i.e. learning that directed its achievements in the context of a real life skills or in the natural environment. (2) Meaningful learning , i.e. a learning that provides the opportunity to the students to carry out their tasks which means. (3) Learning by doing, i.e. a learning that conducted by providing meaningful experience to students.(d) Learning in a group , i.e. a learning that is conducted in a group work. (4) Learning to know each other deeply , i.e. learning that create togetherness, cooperation and mutual understanding one another in depth (5) Learning to ask, to inquiry, to work together , i.e. the learning conducted an activity, creativity, productivity and concerned with the cooperation. (6) Learning as an enjoy activity, i.e. the learning was conducted in a pleasant situation.

Research Results Kadir and Mayjen [3] indicates that contextual teaching and learning can improve the communication capability, students learning activity, the ability to convey opinions and asking skills Suryawati, et al. [11] stated that the group with the contextual learning have troubleshooting capabilities that better compared with conventional learning. Additionally, Widiati [12] in her research "To Develop Problem-Solving Skills Through Contextual Learning concluded that the students who have a low level problem solving skills experienced, have a significant increasing in problem-solving abilities after learning with contextual approach. While students with problem solving skills high levels and tends to be stable. This means learning with contextual approach can improve students' problem-solving abilities.

The aims of this research were to describe: 1) the implementation of contextual teaching and learning in Differential Equations ,2) the students response after implementation of contextual teaching and learning in Differential Equations.

II. RESEARCH METHOD

This research is a quantitative descriptive research. Thirty four students of fifth semester in Mathematics Education Program FKIP Universitas Muhammadiyah Surakarta who enrolled Differential Equations at Odd Semester 2015-2016 are chosen as the subjects. The data was collected by observation, field notes, questionnaire, and documentation. Observation is used to observe the implementation process of models and device of contextual teaching and learning in Differential Equations. Observations in this study conducted by colleagues as an observer team using observation guidelines. Other things that have not been summarized in the observation sheet was written in the field notes. The questionnaire used to collect data on the student response of the implementation models carried out. The documentation used to document the process and results of research.

The data validation using technique triangulation, the researchers compared the data obtained using different data collection techniques.The technique of data analysis using the flow-method that consist of data reduction, data display and verification. Data reduction is the electoral process, focusing on simplification, abstraction, and data transformation "rough" that emerged from the written records on the field. Data presentation in this study is a narrative text, and tables as structured information that gives the possibility of drawing conclusions. Furthermore, the conclusion and verification. Accordingly, the activity analysis is the process of interaction between the three-step analysis of these data, and the process cycles until completed research activities

III. RESULT AND DISCUSS

Khotimah and Masduki [5] has been designed Differential Equations learning model through contextual approach based on discovery. The model has implemented in a class on Tuesday 8 September 2015 at 09.30 - 12.00 on First Order Differential Equations with indicator: to formulate first order Differential Equations from the real issues, to explain separable Differential Equation, to change Differential Equation with a variable has not been separated into the form of a separable Differential Equations, to solve the separable Differential Equations, to explains the initial value problem, to distinguish the general and particular solution.

In the implementation phase of the model, lecturer initiates the learning core activities with illustrations convey the daily problems related to first order Differential Equations that is the issue of population growth and cooling coffee. This activity is a stimulation stage. Contextual teaching and learning component developed is questioning. Furthermore lecturer divides students into several groups which each consists of 3 students. Each group is given a worksheet about the coffee cooling issues to be discussed during 50 minutes. The problem is:

> " In a meeting room, the temperature is 25 ^{0} C . The temperature of a cup of coffee that is available in each table is 70 ^{0} C. After 15 minutes the temperature of the coffee become 30 ^{0} C. If the rate of its cooling is proportional to the difference between the coffee temperature and its surroundings (room temperature), how much will it cool during 30 minutes?"

This is the stage of the problem oriented. The learning components that developed are learning community and questioning.

The next stage of contextual teaching and learning based on discovery is the data collection, where the students discuss the problem given in a group. Students dig the information known in the problem together, search for the information needed to solve the problem and then formulate the strategies solution of the problem . At this step, students are encouraged to formulate the relationships between the variables in the problems which is given. In the coffee cooling problem above students are expected to understand the meaning of the statement " the rate of its cooling is proportional to the difference between the coffee temperature and its surroundings (room temperature)". In this stage students prompted reviewing the matter what is required to solve the problem At this stage the contextual teaching and learning components developed are learning community , questioning , and constructivism .

The next stage is data processing , data or information that has been obtained from the data collection stage processed by solving the problem with the suitable strategy that has been arranged and unmask in the form of a written report to be presented in front of the class. At this stage, the contextual teaching and learning components developed are learning community, questioning, constructivism and inquiry .

The next step is verifying where a representatives group presents the discussion results in front of the class while the other groups give response. At this stage, the lecturer also provides the response or confirms the discussion result that presented. The contextual teaching and learning components developed are learning community, questioning, and modeling . After the participants presented the results of their group work, the lecturer and students together make conclusions for the material learned. This stage is called generalization . In generalization stage, students facilitated the lecturer have been able to find their own concept of separable Differential Equation, to change Differential Equation with a variable has not been separated into the form of a separable Differential Equations, to solve the separable Differential Equations, to explains the initial value problem, to distinguish the general and particular solution.

At the end of learning, lecture and students have a reflection for the learning prosess done. Students fasilitated by the lecture discuss matters that has been understood and not, try to find what its causes. In the implementation of contextual teaching and learning, there is also authentic assessment which covers the assessment of the attitude during the learning process and assessment of the individual at the end of the lesson.

The implementation of contextual teaching and learning based on discovery in Differential Equation can be seen in the picture below:

Fig 1. Stimulation

Fig 2. Problem Oriented

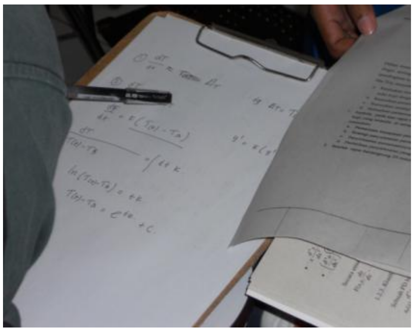

Fig 4. Data Processing

Fig 3. Data Collection

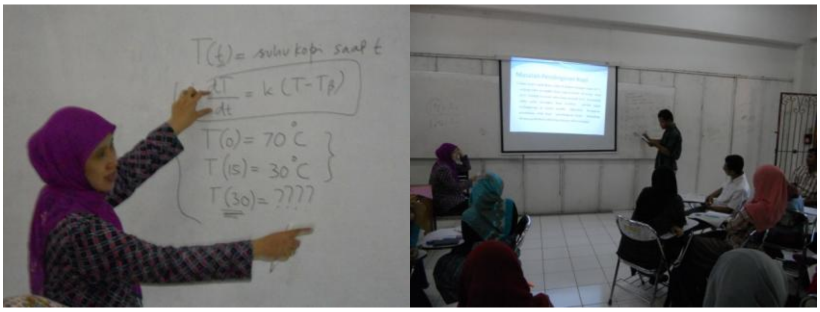

Fig 5. Verification

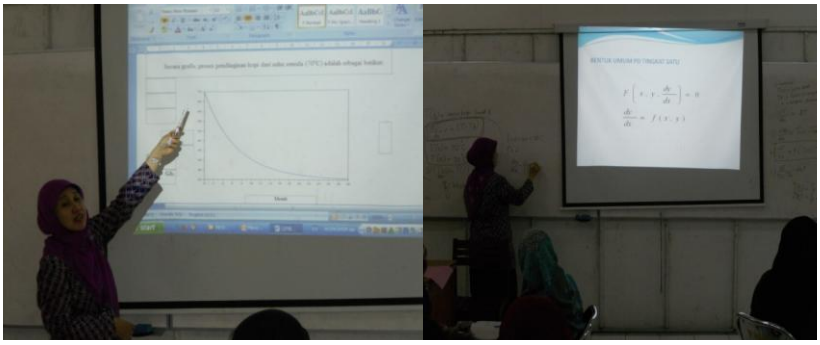

Fig 6. Generalization

The implementation of contextual teaching and learning is carried out during 4 sessions in class with different materials and using worksheet students as a learning media. After the implementation, students asked to provide their response to the implementation of the models being developed. The response given by giving a check mark (v) on the column number to a line with the given statement. The response from the students to the implementation of learning outlined in table 1 below.

Table 1.
Students Response to Implementation Model

NO	Statement	Average Scores	Criteria
1	In the beginning of learning given the illustration problems in daily life that related to the materials.	3,59	Very Good
2	The purpose of the lesson every meeting conveyed clearly.	3.65	Very Good
3	The steps in the process of learning activities presented to the students.	3.74	Very Good
4	Lecturer facilitates student recall the matter- previous material related to the materials to be learned.	3,59	Very Good
5	Learning model used is able to encourage students to build their own knowledge through active engagement in the learning process (*Constructivism*)	3,21	Good
6	Learning model used is able to encourage students to find their knowledge itself (*Inquiry*)	3.09	Good
7	Learning model used is able to encourage students to ask, dig information, confirm what is already known and directs attention to the aspects that have not known (*Questioning)*	3.29	Good
8	Learning model used is able to encourage students to study in groups (*Learning Community*)	3.41	Very Good
9	Learning model used are able to encourage the students to convey/ provides an example of the model in solving the problems (*Modeling*)	3,21	Good
10	Learning model used has facilitated a lecturer with the student to discuss the materials that has been understood by the student to discuss the materials that are not yet understood and explore the causes (*Reflection)*	3,44	Very Good
11	In learning process, autentic assessment does not only assess the aspects of knowledge, but also skills and attitudes aspects.	3,44	Very Good
12	The problems in the student worksheet and tasks related to problems in daily live.	3.74	Very Good
13	The problems in the student worksheet and tasks stimulate students to be able to understand the problem.	3.26,	Good
14	The problems in the student worksheet and tasks stimulate the students to be able to devise a strategy problem solving	3.24	Good
15	The problems in the student worksheet and tasks stimulate the students to be able to use the strategy for troubleshooting.	3.18	Good
16	The learning model encourage the students to be able to make the relationship between the variables in the problems given	2,97	Good
17	The learning model encourage the students to have a skill in doing the manipulation of mathematics calculation.	3.29	Good
18	The learning model encourage the students to be able to create a generalization or conclusion	3,15	Good
19	The learning model encourage the students to understand the concepts of Differential Equation materials	3.32	Good
20	The learning model encourage the students to be able to explain	3.12	Good

	the knowledge that belongs to logically (in discussion or presentation)		
Average Total		3.35	Very Good

Source : Data Processing

Table 1 shows that the students gave a positive response for the implementation of contextual teaching and learning based on discovery in Differential Equations. In addition, the total average score of the questionary is 3.35 which means that the implementation of the learning model developed gets the criteria "Very Good". The positive response from the students also can be seen from the preceding questioners openly like as follows:

a. Contextual teaching and learning make learning more interesting for the students since they can see the usefulness of material in a real life. In addition students understand the origin of the formula obtained.

b. With the model of contextual teaching and learning, the lesson becomes more easily understood because using the examples of daily life and the environment.

c. Contextual teaching and learning model encourage students to study in groups and find knowledge itself.

d. The implementation of contextual teaching and learning based on discovery in Differential Equations is very good, because the learning process begins by giving an example in real life and students are stimulated to be able to process the information independently. Thus the learning process can make students to take an active role.

e. The Differential Equations using contextual teaching and learning is good, because the model of contextual learning students are required to think and find their own solutions to the problems that have been given.

f. Contextual teaching and learning encourage students to express their opinions and ideas

g. By contextual teaching and learning in Differential Equations, the learning process is very fluently and it can build the pattern of thinking coherently.

h. Contextual teaching and learning can make the students have a skill in working on the task by finding out their own solution to the problems that given.

i. Contextual teaching and learning can increase the motivation and enthusiasm to work.

This results shows that the students give appreciation or a positive response to the use of learning model with contextual approach. The students see that the model of teaching which is applied pushes or gives the positive aspects in learning as expected to appear in the contextual teaching and learning, that are actively involved in building knowledge (constructivism) , encourage students to find their knowledge itself (inquiry) , encourage students to ask , dig information, confirm what is already known and directs attention to the aspects that have not known (questioning) , encourage students to study in groups (learning community) , encourage students to convey/ provides an example of the model in solving the problems (modeling) , facilitate lecturer with the student to discuss the materials that has been understood by the student to discuss the materials that are not yet understood and explore what Causes (reflection) , and give a complete assessment in learning (authentic assessment).

This is in accordance with the opinion of Rusman [9] which states there are seven principles that must be developed in contextual learning: constructivism , inquiry , questioning , learning community , modeling , reflection , and authentic assesement . The principle of finding on contextual approach in Differential Equation learning process using the sense of discovery . On the meaning of discovery real issues resolved is the problems that engineered by teachers and lecturers, for example with the given conditions or certain assumptions. While in the sense of inquiry real issues that developed is the problem that what is or is not engineered. With the discovery learning, the students not served the knowledge in the form of final borders but are encouraged to organize their own knowledge. Thus the discovery learning students are required to be actively involved in finding the concepts or principles through observation, classification, discussion and conclusions. According to the Shah [7] there are six procedures for implementing discovery learning, that are stimulation, problem oriented , data collection, data processing, verify, and generalizations.

The results of this research is also supported by Rasmussen and King [8] that develop learning design of Differential Equation in the perspective of Mathematics Realistic Education (RME) to help the discovery process on the first order Differential Equation . The results of the research showed that the students have the conceptual abilities in counting and settlement process, and able to develop informal Euler method in solving the problem. In addition , Slavit et al. [10] also develop learning by combining the technological (web-based), student based learning (student center), and context-based learning with supported by activities such as discussion and conceptual based. Based on the results of research, the combination of learning model is able to help develop relational understanding of the concepts of Differential Equation and the solution. Kamaruddin and Amin [4] in his research entitled "Impact of Contextual Video in Learning Engineering Statistics" concluded that the use of contextual video can assist students in learning statistics class at the faculty of engineering to understand the statistical material.

Thus the researches that have been carried out above support the results of this research,that is the student response of the implementation of contextual teaching and learning in Differential Equation learning is very good.

IV. CONCLUSION

The implementation of contextual teaching and learning based on discovery in Differential Equation learning includes the components: 1) questioning on stimulation stage, 2) learning community and questioning on problem oriented stage, 3) learning community, questioning, constructivism, and authentic assesment on data collecting stage, 3) learning community, questioning, constructivism, authentic assesment and inquiring on data processing stage, 4) learning community, questioning and modeling on verification stage, and 5) constructivism and reflection on the generalization stage.

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ME – 70

Analogy Reasoning Ability Students' In Solving Algebra Problem Based On Sternberg Theory

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Abstract— The average achievement of Indonesian students' mathematics skills according to Benchmark International Trends in Mathematics and Science Study (TIMSS) 2011 is generally in low level which is ranked at the 38^{th} out of 42 countries and according to the survey result in Program for International Student Assessment (PISA) 2012, it is ranked at the 64^{th} out of 65 countries. The low mathematics skill of Indonesian students' has become an important reason to research more deeply about reasoning and algebra in Mathematics. Analogical reasoning is a very important component in Mathematics because it is the key of creativity and it can make the learning process in the classroom become effective. Sternberg theory is theory of first analogical reasoning. Component of analogical reasoning are encoding, inferring, applying and verifying. Therefore, this study purposes to discuss the students' analogical reasoning ability in solving algebra problems based on Sternberg theory. In this study, the data were derived from the results of measurements instruments algebra problems. The subjects of this research were 2 students from class XII of Senior High School 15 Surabaya. The sources of data were derived from the results of thinks aloud, the transcribed interviews, and the videos taken while the subject working on the instruments and interviews. The collected data were analyzed using qualitative techniques. The result of this study discussed and described qualitatively. The result of this study described the differences of analogy reasoning ability from all the research subjects.

Keywords*: analogy reasoning ability, algebra problem, Sternberg theory.*

I. INTRODUCTION

The end of the year 2015 will be the deadline for Indonesia to enter the ASEAN Economic Community (AEC) which opens the boundaries of the rules on tax, tariffs, and bea for goods and services in Southeast Asia. AEC's presence also will affect not only the free trade sector for a variety of goods but will also affect the labor sector. With AEC, ASEAN countries will freely compete to fill the labor sector in the ASEAN countries. For countries that have a workforce with educational qualifications and high competence, MEA will be an opportunity to expand the workforce to other ASEAN countries.

The Central Statistics Agency per August 2013 mentions that graduates Indonesian labor workers are graduates of Elementary School to the bottom amounted approximately 52 million people (46,93%), or almost half of the total trade amounted to 110.8 million people. Then the worker graduates from junior high school of 20,5 million people (18,5%), workers graduate from senior high school amounted to 17,84 million people (16,1%). The lowest number observed in the number of workers from university degrees with 7,57 million (6,83%) and a diploma in a number of 2,92 million (2,63%). According to data from the Department of Statistics Malaysia (DOSM) in 2012, the number of Malaysian labor is 13,12 million people with posture to reach 7,32 million people (55,79%) are high school graduates and some 3,19 million people (24,37%) are university graduates and diploma. ASEAN countries such as Singapore, according to data from the World Bank in 2012 had a workforce of 3,22 million people with a high school graduate workers of 49,9% and university graduates and diploma of 29,4%.

From these data we can see that almost total labor of Indonesia (46.93%) is low-skilled labor elementary school graduates who are a contrast compared to Singapore and Malaysia, about 80% of its labor are graduates of high school and colleges. This implies unpreparedness Indonesia in the free labor market in ASEAN if MEA imposed per December 31^{th}, 2015.

In these conditions, the education has a tough task to deliver skilled workers educated (skilled labor), has character, fighting spirit, and hard work. Curriculum 2013 mandate to next generation was productive, creative, innovative and effective, so that we can become a competitive collaborative nation. Strengthening the attitudes, skills, and knowledge are integrated into the key word. When referring to the development of Human Resources (HR), especially the world of education, the main problems are still complacent on the issue of material or a mere formality.

The educational system should focus on the skills and abilities necessary in the era of economic and hone the skills of in-depth analysis to increase productivity. Analytical ability requires reasoning skills to solve complex problems. However understanding of the competence of reasoning is still diverse and often confused how its implementation in the classroom.

This is consistent with the purpose of learning mathematics in schools that not only in the mastery of mathematical concept, but also directed at improving students' skills in reasoning, solving problems, communicating ideas, and have respect for the usefulness of mathematics in life [1]. Based on the curriculum, reasoning ability is very important in learning mathematics.

Mofidi [2] describes the types of reasoning in mathematics is divided into three that is inductive reasoning, analogy reasoning and deductive reasoning. Based on the three point of view, reasoning analogy is a part of the kind of reasoning that are important in mathematics. Analogy reasoning ability can be measured through the stages of Sternberg analogy reasoning. Therefore, this article discusses the analogy reasoning abilities in solving algebra problems based on the theory of Sternberg.

Analogy according to Indonesian Dictionary is an equation or correspondences between the two objects, or two different things [3]. Analogy reasoning by Gust and Kunhnberger is an important ability of human cognition, because the analogy can be used to explain many aspects of cognitive creativity, productivity, and adaptivitas [4]. Meanwhile, according to Antal explains that the analogy reasoning in a wider sense can be defined as that reasoning based on similar, while the analogy reasoning in a narrow sense is defined as reasoning about the relationship between the elements similarity [5]. Analogy reasoning by this study is the decision-making process based on use of the framework or the logic thinking that is identical between source problems (known problems) and the target problem (the problem to be solved).

Sternberg [6] explains that the components of analogy reasoning is as follows:

a. Encoding/Encryption, that is identifies any form of analogy with the code of the characteristics of each form of the source problem (known problems).

b. Inferring, is looking for identical relationships contained in the source problem (known problems).

c. Mapping, is looking for a relationship that is identical between source problems (known problems) and the target problem (the problem to be solved), or establish the conclusions of similarity relationship between the source problems and target problems.

d. Applying is the process that produces or choose a suitable form for completion analogy, (that is establish equivalence between the first and second pair).

Reasoning ability by Herdian includes: (a) reasoning commonly associated with the ability to find solutions or solving problems, (b) skills related to the conclusion as to the syllogism and which relate to the ability to assess the implications of an argument, and (c) the ability to see relationships between objects or ideas, and then use those relationships to obtain objects or other ideas. Based on the above definition that included analogy reasoning ability is the ability to see relationships between objects or ideas, and then use these relationships to acquire objects or other ideas [7].

The indicator that students' has mastered the mathematical reasoning ability by Sumarmo are [8]:

a. Creating a logical conclusion.

b. Giving explanations using pictures, facts, properties, and relationship.

c. Estimating answers and process solutions.

d. Using the pattern of relationships to analyze, create analogies, generalizations and develop, and test the conjecture.

e. Asking opponent example.

f. Asking inference rules, check the validity of the arguments, and draw up a valid argument.

g. Develop direct evidence, no direct evidence, and evidence with mathematical induction.

The indicators on the analogy reasoning ability Sumarmo in accordance with the analogy reasoning component Sternberg. First, indicators of find the relationships pattern to analyze, making an analogy, generalization, develop and test the conjecture at this Sumarmo including first analogy reasoning component Sternberg that is encoding. Seconds, indicator of logical conclusion on Sumarmo including second analogy reasoning component Sternberg that is inferring. Third, indicator of estimating answers and process solutions on Sumarmo including third analogy reasoning component Sternberg that is applying. Fourth, indicator of check the validity of the arguments and draw up a valid argument on Sumarmo that is fourth analogy reasoning component that is verifying.

II. RESEARCH METHOD

This study is a qualitative research because the results will be obtained which revealing analogy reasoning abilities of students through algebra problems based on the theory of Sternberg. This research was conducted in SMA Negeri 15 Surabaya. The subjects were high school students of class XII as 2 students. Students selected are students who have high math skills based on classroom teachers and have good communication.

The data collected in this study came from data of algebra task sheet. Sources of data in this study is derived from the results thinks a louds, interviews were transcribed, and the video for the subject work task sheet and interviews.

The data collection is done by giving the problem to a student's completed. In the problem-solving process, students are asked to express aloud what he was thinking. Researchers recorded the verbal expression of students and record the behavior (expression) students including unique things students can do when solving the problem. When the students have finished working on the problem, then do the same for other students to obtain the desired subject. The collection of such data is called the Think Out Loud or Think a louds.

The collected data were analyzed using qualitative analysis techniques, one model is interactive analysis techniques. In this study, the preparation of the unit based on the problem studied: encoding, inferring, applying and verifying. Further, categorization performed by the students' answers encode either expressed verbally or in writing is done.

III. RESULT

In this research study designed instrument that aims to develop analogy reasoning ability students' through algebra problems. The mathematical tasks sheet in this study are presented in Figure 1 below.

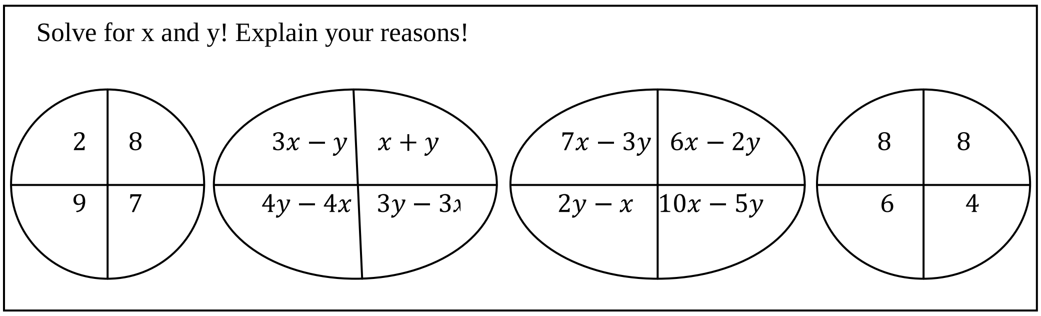

FIGURE 1. RESEARCH INSTRUMENTS

In the above research instrument formulated in such a way that requires students to investigate the context, because not all of the data provided. In the closed-ended algebra problems (especially Systems of

Linear Equations Two Variables) are known constants in each equation, but the research instrument is a constant value there are various kinds so that requires students to identify and find patterns or relationships of what is happening in each circle and then drawn conclusions on the statement. The subjects in this study is 2 students (S1 and S2). Furthermore, in analyzing the results of this study using constant comparison technique where each group selected two subjects to be analyzed.

When doing the question, S1 connected the numbers in the first circle using addition operation so that the result showed 26. Hence, S1 added the numbers in the fourth circle so that the result showed 26. Based on that case, S1 got the encoding problem. Then, S1 concluded from the relation obtained that is if each circle is summed up the result will show the same number, it is 26. In the other word, S1 got the characteristics code from that question. From that case, S1 applied the inferring that is marked as the known relation from this question. The question of S1 that related to inferring is shown below.

S1 : So, the second way is sum up all the equation in the circle...

In base domain, it has been found that the relation from the first circle and fourth circle is summing up every part of circle equals 26. Therefore, S1 summed up the variables in the second circle equalized 26 and then summed up the variables in the third circle than equalized 26. In the other word, S1 had applied the relation from each characteristics code in base domain found from the target domain. Based on that, S1 applied the relation that was S1 had known to target domain. The statement of S1 related to the applying characteristics code was collected from the interview below.

P : Do you understand the meaning of that question? Please tell me what does it mean?

S1 : There is correlation among these four pictures (pointing all four circles). If the left circle (the first circle) and the right circle (the fourth circle), has the total.. It has the same total that is 26, then... my conclusion is, these two circles automatically (pointing the first circle and second circle) have the same result as this circles (pointing the third circle and the fourth circle).

Based on the reasoning process, it seems that S1 is in the analogy reasoning step. When the answer was found, S1 did not verify or check the correctness level of the answer. However, after clarified using interview, S1 was convinced that the answer was correct. The quotation of some interview related to the convenient of S1 to the low of the answer is shown below.

P : are you sure with your answer?

S1 : yes, I'm sure.

When the researcher repeated the question "how did you check your answer if you sure that it is correct?", S1 answered by "apply it into one of the equation". Then, the researcher asked the next question "Have you checked it?", S1 answered "No, not yet". And the researcher asked "Why did you say that you are sure with your answer but you have not check it yet?", S1 laughed and asked a question "Should I check it?" the researcher answered 'yes please'. Then, S1 substituted the $x = 3$ and $y = 5$ to one equation in the second circle. After substituted it, S1 found the appropriate equation value, therefore S1 be sure about the correctivity of the answer. Therefore, S1 did verification or it can be called as a process of checking the rightness of answers. The statement of S1 related to the verification result is written below.

S1 : Emm… apply it to the equation found from the relation of these two circles (pointing toward the second and the third circle). So, from the fisrt circle, it is found that $-3x + 7y = 26$, so $-9 + 35 = 26$. Then for the second equation, $22x - 8y = 26$, $22x$ this is 66minus $8y$ … fourty equals twenty six.

When the first time encounters a problem, S2 has been able to notice the relation consisted on the fourth circle that is looking at the numbers or variables that are compatible. When identifying the problem, S2 connected the numbers and the compatible variables from the first circle to the fourth circle. The relevancy of those numbers or corresponding variables is the sum of the corresponding variables between the second circle and third circle equalized the sum of corresponding numbers between the first circle and the fourth circle. The relations obtained by S2 based on the encoding problem is the sum of variables in the corresponding parts between the second circle and third circle equalized the sum of the numbers in the corresponding parts between the first circle and the fourth circle. In this case, S2 has made the code characteristics of the mathematics assignment sheet. Therefore, S2 structured the relation that characterized by the familiar relationship of each corresponding parts between the base problem and the target problem. From that case, S2 applied the inferring. The occurrence of S2's relation inferring is marked by the familiar partial relation in this problem by the S2, with the following statement.

S2 : So this (pointing the question) tried ... if this (pointing to the top left side of the second image) with this (pointing to the top left of the third image) summed and the result is equals to this (pointing to the top left side of the first image) and this (pointing to the top left side of the fourth image) summed up.

First, S2 connected the top left and top right side only. Furthermore, S2 applying the relation that was acquired to the other parts that are the bottom left and bottom right side. Therefore, S2 has applying the relation between base problem and target problem or applied the problem relations or code characteristics derived from the first part that are related to the other part between base problem and target problem. The transcript of the interview related to the applying relation is shown below.

P : The conclusion means that there is a relationship in all charts start from first diagram to fourth diagram, do what, so what is the relation?

S2 : Addition ...

P : Only addition? What kind of summation?

S2 : The value at the same location.

S2 was uncertain about the value of $\mathbf{x}$ and $\mathbf{y}$ found. So that S2 tried to check the answer by relating the other sides that are the bottom left side and the bottom right side. The summation of the bottom left side in the second circle and the third circle that was equalized to the summation of the bottom left side in the first and the fourth circle create the third linier equation of two variable, whereas the summation of the bottom right side of the second circle and the third circle that equalized to the summation of the bottom right side in the first and fourth circle created the fourth liner equation of two variable. Therefore, S2 verified the result or rechecked the correctness of the result. Here is the statement of S2 related to the verification result. The quotation of interview related to the verification result of S2 is presented below.

P : please explain, how did you answer that question?

S2 : So, $x - y$ add with $7x - 3$ (pointing on the top left side of the second picture and the top left side of the third picture) then equals two plus eight (pointing toward number 2 in the first picture and number 8 in the fourth picture), then the numbers in the same position are counted up... after that the others numbers in the same side or position (pointing toward the other side from each picture) are then eliminated and substituted.. Finish…

Based on the verification result, S2 find the new value of $\mathbf{x}$ and $\mathbf{y}$ that are $x = 3$ and $y = 5$. From the worksheet, it can be estimated that S3 did not check the answer, but after it is clarified through interview, it is known that S2 felt convinced with correctness of the answer.

In the process of reasoning for the S2's first way, it seems that S2 has already known the problem, the part of relation, and the solving strategy. Based on the result of think out louds and that interview, S2 had a encoding problem, inferring relation, and applying relation. The conclusion is the analogical reasoning of S2 is complete. It start from the encoding, mapping, applying, and verifying. In this case, S2 interpreted the characteristic code formation with the connective external structuring that is by correlating the related parts between base problem and target problem.

IV. CONCLUSION AND RECOMMENDATION

Based on the above discussion it can be concluded that the analogy reasoning ability is important for learners in the face of ASEAN free market. Understanding and definition of the concept of analogy reasoning ability varied, but it should be viewed objectively and realistically as the spectrum to enrich the wealth. Whereas, in the implementation stage in front of the class, should be suitable to the characteristics of each lesson. For mathematics it is starting to get attention and even become a new perspective.

Based on the indicators of mathematical reasoning ability analogy, this study came to the conclusion that the analogy reasoning ability students directly only meet three components Sternberg is encoding, inferring, and applying, while verifying component is not directly expressed in algebraic problem solving. Therefore, in the learning should be emphasized the concept of rechecking the answers of students in solving mathematical problems or problems of any kind.

Analogy reasoning abilities students in this study only through algebra problems. Therefore, it needs to be further developed analogy reasoning ability with other fields, both on other materials in mathematics and in areas other than mathematics.

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Accomplishing Mathematics Problems Using *Outside The Box* Thinking Phase

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Abstract – Completion of math assignment is an important part of learning mathematics. However, in practice, students often do it in a way that is not creative (monotone). In other words, students are not able to think outside the box. This research described the process of students' thinking outside the box when they completed a math assignment using outside the box thinking phase. Outside the box thinking phase in this research included exploration, idea generated and justification. This research is important for educators to make thinking *outside the box* as the information input about the characteristics of students' thinking. The research instruments that had been validated by expert *validator* were given to the subject of research to be completed. To obtain accurate data, the subjects of the research accomplished it using think aloud technique. The subject of research explored the problem to get an idea of the problem situation. In this case the subject used logical reasoning in order to obtain an idea of different solution. The research subjects used fractions to strengthen the mathematical argument. The conceptual component of cognitive function happened was analyzing-integrating. Analyzing-integrating is the cognitive functions related to the quantity of a concept.

Keywords: *mathematical assignment, phase, outside the box thinking*

I. INTRODUCTION

Mathematical tasks completion does not stop at just getting the result but it also needs to pay attention to the process of accomplishing them that brings creativity of students. "Working on mathematical tasks may influence not only the mathematical content that is learned [1]". Creative behavior of students can be seen from the way the students argue/mathematical reasoning toward the completion of the math task generated. In generating different ideas on task completion, the students are given the opportunity to explore creatively so it is expected later the student will have autonomy and trust and they no longer use the standard thinking pattern (commonly thinking), that is pattern of thinking that only uses the basic algorithm skill.

"Reference [2] says creative thinking as *"out of the box thinking"* or *"outside the box thinking"*, which is a way of thinking "out" of the natural way of thinking *(get out of out our own box)."* Mental *"box"* is defined as the restriction created by people for themselves. The human brain has an efficient way of working. In other words the brain develops thinking patterns that recur every day, so it evolves into a "monotonous *(default)"* mental. Therefore, when brain faces a decision or a challenge, then it will easily estimate the limits of perspective that can be done. It means "monotonous" mental sometimes affects all activities undertaken. The existence of "monotonous" mental sometimes create a zone of "happy *(*comfortable*)"* which leads to a reluctance to upgrade their quality.

"Reference [3] describes the definition of *"thinking outside the box is generally associated with innovation and problem solving in business and management"*." Thinking *outside the box* is a term used to denote the level of thinking that is higher, that is, when the quality of task solution or completion idea is substandard and the solution has not been found. "Thinking outside the box (thinking out of the box or thinking beyond the box) is a metaphor that means to think differently, unconventionally, or from a new perspective. This phrase often refers to novel or creative thinking" [4]. Thinking *outside the box* associates with a willingness to get out of a happy *(*comfort*)* condition (zone) psychologically, open new perspectives toward the task, and the willingness (challenged) to explore. Therefore, this research is intended to describe the phases of thinking outside the box students in solving mathematical tasks. Stages or phases of thinking *outside the box* show the characteristics of the students to think outside the box to produce a different solution.

This research is important to know the characteristics of thinking *outside the box* in solving mathematical tasks through the behavior that can be observed. The activity of students' thinking *outside the box* is a thinking orientation that is "potentially" in the future. This is because thinking *outside the box* is a part of creativity, and creativity itself is a part of self-actualization at the highest level of Maslow's hierarchy of human needs. In addition, the research of thinking outside the box can be a contribution to enrich the knowledge of the thinking process, especially in mathematics.

II. LITERATURE REVIEW

Creativity based on the investment theory [5] contains six interrelated components namely intellectual abilities, knowledge, styles of thinking, personality, motivation and environment. Intellectual skills include (a) synthetic ability that is the ability to see the problem in a new way, out of the boundaries of conventional thinking; (b) analytical ability that is the ability to distinguish useful ideas which could be studied further than the idea that is less potential; and (c) practical-contextual ability that is the ability to convince others about the value of the ideas obtained. To be creative, one must generate new ideas, analyze the idea and present them to others.

"Creativity is the ability to bring ideas or works of art that are new, surprising and valuable" [6]. "Creativity involves the generation of ideas or products that are original, valuable or useful" [7]. Creativity associates with interesting and unimaginable previously new ideas. "For many there is an echo here of the intuition that "thinking outside the box" can be more creative than "thinking inside the box" [8]. It requires a more creative style of thinking that is thinking outside the box.

Thinking outside the box is different from lateral thinking [3]. Thinking outside the box is a linear way of thinking while lateral thinking does not create a new idea in a linear way but it finds in the "deviant" way. To be able to think outside the box, one must leave the comfortable zone psychologically (common routines), be opened with a new perspective toward a task, and bold (interested) in facing challenges. In addition, people who think outside the box should discard the character rigid, high personal egoism, and be able to manage emotions well.

Various models of problem solving are proposed by several researchers, including [9] with his famous completion stages that are widely used by other researchers. They are understanding the problem, divising a plan, carrying out the plan, and looking back. Problem solving in thinking outside the box is the problem solving that does not restrict students to explore the problem and to use the right strategy (uncommon ways) to produce different solutions. Thinking outside the box in solving mathematical tasks are through three phases or stages namely exploration, ideas generated and justification. Exploration phase has two criteria namely problem exploration and interpretation (mathematical interpretation). In interpreting a math assignment, students use the prerequisite knowledge previously possessed. The phase of ideas formation (ideas generated) contains two criteria, namely conjecture and representation. In making conjecture, the resulted solution strategy is different solutions strategy while justification phase contains the criteria namely justification. Justification toward the solution of mathematical tasks is reviewed through the logic and accuracy of students in completing the tasks. The process of settlement which is logical and right shows the understanding depth of the mathematical concepts that have been taught.

III. RESEARCH METHODS

This research is a qualitative research using Grounded Theory Approach. The purpose of grounded theory approach is data theorization that is the research does not start from a theory or to test the theory, but it starts from the data towards a theory. Based on the schedule agreed upon, the researcher gave a math assignment or task to the research subjects to be completed. The researcher used think alouds technique, the researcher observed the research subjects when completing the math assignment, and recorded all the activities of research subjects by using a digital camera. The observation result was not only in the form mathematical tasks completion but also in the form of moving images recording (video) of the students when they did the math task completion activities. To complete the observed data, the researcher conducted semi-structured interviews with a purpose to deepen the process of students' thinking outside the box.

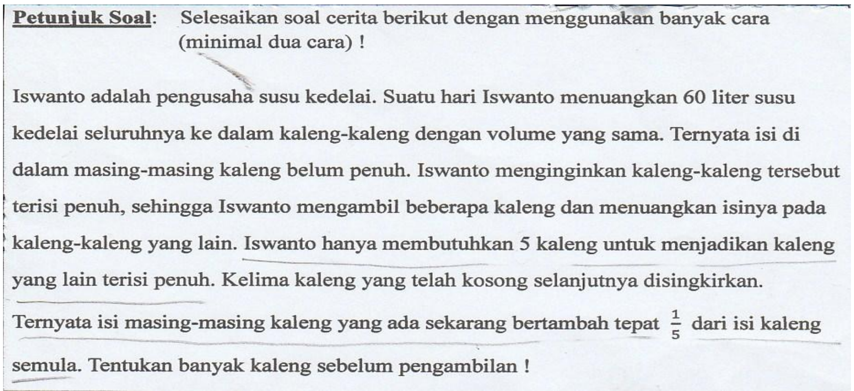
At this phase of data analysis, the researcher conducted a series of activities including: (1) transcribing verbal data namely data obtained from think alouds and semi-structured interviews; (2) studying all data both verbal data and field notes; (3) reducing the data to create abstractions; (4) arranging and coding the based on the stages or phases that have been designed, namely the exploration, idea generated and justification; (5) drawing conclusions about the process of students' thinking outside the box in solving a math assignment using the exploration stage, idea generated, and justification.

IV. FINDINGS AND DISCUSSION

The research subject was asked to work on the instrument using the think alouds. The Subject wrote down the steps of completion while speaking, told everything he was thinking dealing with the completion steps that he wrote. The subject was very cooperative, and he had no difficulty in communicating with the researcher to communicate the results of the work. The subject was very confident, as seen from the loud noise sounded when he did think alouds. The subject provided two completion ways. In exploration phase (exploration), the subject understood the problem by formulating the information on the task (what is known?) and the objective which would be reached (what was asked?), and the subject read the questions aloud:

> Here known Iswanto only needs 5 tin cans to make another fully filled. All empty cans are removed. It means the five cans are used to fill $\frac{1}{5}$ part of the other cans. Here Iswanto needs 5 cans to fill all the remaining cans. Then the $\frac{1}{5}$ is the part that is not filled yet.

Based on the result of transcript, the problem situation on the mathematical task is understood by the subject that the content of tin cans was completely used to fill $\frac{1}{5}$ part of the other cans. The subject also underlined the sentence that he considered important (sentences that provided information) as Fig. 1 below. The underline shown by the subject showed that the subjects marked the important data which were known, identified the problem and tried to interpret them.


Petunjuk Soal: Selesaikan soal cerita berikut dengan menggunakan banyak cara (minimal dua cara) !

Iswanto adalah pengusaha susu kedelai. Suatu hari Iswanto menuangkan 60 liter susu kedelai seluruhnya ke dalam kaleng-kaleng dengan volume yang sama. Ternyata isi di dalam masing-masing kaleng belum penuh. Iswanto menginginkan kaleng-kaleng tersebut terisi penuh, sehingga Iswanto mengambil beberapa kaleng dan menuangkan isinya pada kaleng-kaleng yang lain. Iswanto hanya membutuhkan 5 kaleng untuk menjadikan kaleng yang lain terisi penuh. Kelima kaleng yang telah kosong selanjutnya disingkirkan. Ternyata isi masing-masing kaleng yang ada sekarang bertambah tepat $\frac{1}{5}$ dari isi kaleng semula. Tentukan banyak kaleng sebelum pengambilan !

FIGURE 1. SUBJECT UNDERLINED THE SENTENCES THAT SHE CONSIDERED IMPORTANT

In Fig. 1, the Subject underlined two sentences: (1) Iswanto only needs 5 tin cans to make the other cans fully filled; and (2) the contents of each tin now exactly added $\frac{1}{5}$ more than before. However, the subject did not underline the objective (what is asked?). Subject interpreted the problem by considering $\frac{1}{5}$ part of each other cans was not filled yet, as written by the subject in Fig. 2 below. In Fig. 2, the subject wrote down the results of the interpretation in two sentences: (1) 5 cans for all cans; and (2) $\frac{1}{5}$ part of cans were not filled. The results of this interpretation were the description of a problem situation by Subject and designing a plan of the problem solution.

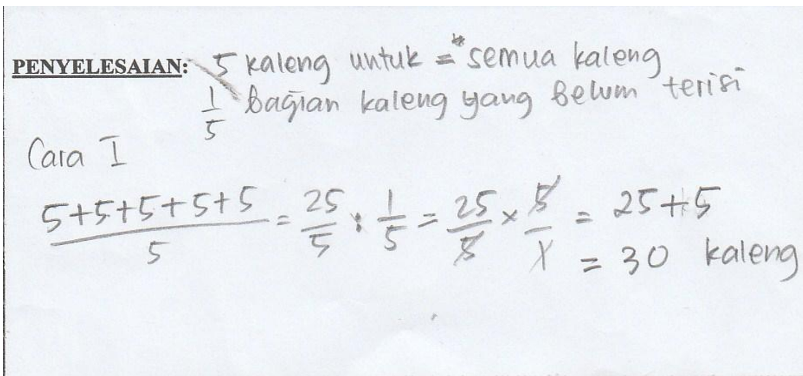


FIGURE 2. THE INTERPRETATION OF SUBJECT

At the phase of forming ideas (*ideas generated*), the subject attempted to purse the problem and found the core of the problem. The core of the problem in the question was that soy milk in the five tin cans was

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poured in the other cans exactly $\frac{1}{5}$ each. To write the steps of the solution, subject recalled about how to convert integers into fractions and the concept of operations on fractions. Further subject implemented the completion strategy (a strategy to determine the appropriate notation) as shown in Fig. 2 While recalling the concept of fractions, Subject wrote 5 in the form of a fraction $\frac{5+5+5+5+5}{5} = \frac{25}{5}$. This was done with the intention to make it easier to perform operations on the division of fractions (equated denominator 5). The next process was dividing $\frac{25}{5}$ by $\frac{1}{5}$ *(*Subject explained the reason, "because five tin cans are used for $\frac{1}{5}$ of the other tin cans, then it is divided by $\frac{1}{5}$"), $\frac{5+5+5+5+5}{5} = \frac{25}{5} : \frac{1}{5} = \frac{25}{5} \times \frac{5}{1} = 25 + 5 = 30.$ Subject did not understand yet the concept of equation as $\frac{5+5+5+5+5}{5} = \frac{25}{5} : \frac{1}{5}$ *(*though $\frac{5+5+5+5+5}{5} \neq \frac{25}{5} : \frac{1}{5}$ *)* and $\frac{25}{\cancel{5}} \times \frac{\cancel{5}}{1} = 25 + 5 \left(though\ \frac{25}{5} \times \frac{5}{1} \neq 25 + 5 \right).$ Subject focused more on the final result. Subject looked again the goals to be achieved by saying, "it means the answer is 25, and it is added with the number of cans required. This is because the question is about the number of cans before being taken. It means 25 + 5 = 30 cans". Thus the final result obtained by the subject was 30.

At justification phase, Subject prepared the second to solve problems in a math task. Subject attempted to use an algebraic method that had been gained in the previous class, but the subject was less able to distinguish the term algebra and variable. Subject applied the strategy using appropriate notation to formulate a mathematical model as shown in Fig. 3 below.

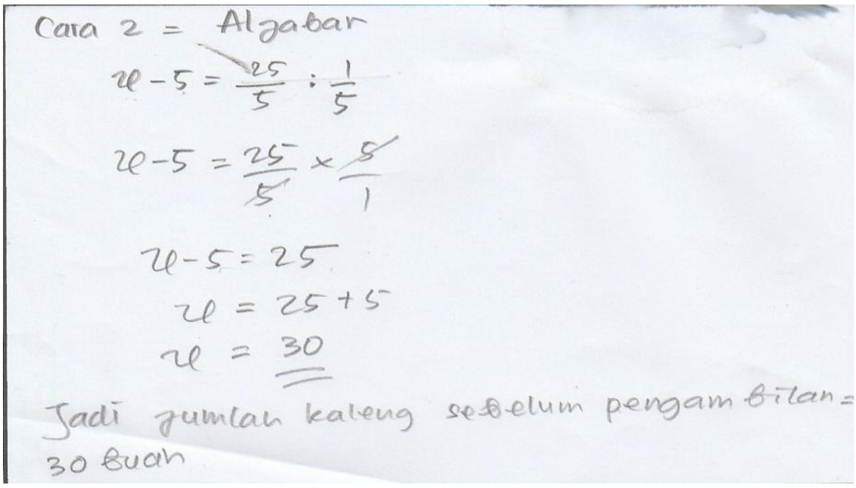
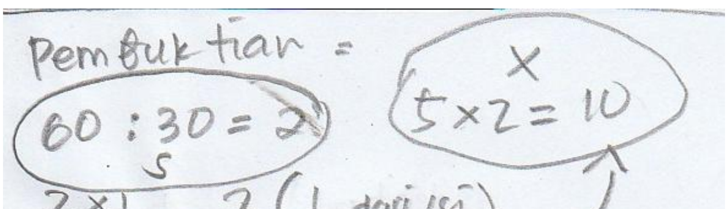


FIGURE 3. THE SECOND WAY OF THE RESEARCH SUBJECT IN SOLVING PROBLEMS ON A MATH ASSIGNMENT

In Fig. 3, Subject implemented the strategy using appropriate notation. Subject let many tin cans before taking x, continued by saying, "because we want to find the number of cans after the decision, then $x - 5$." Subject wrote *"* $x - 5 = \frac{25}{5} : \frac{1}{5}$*"*, subject was able to use the division operation on fractions by first making 5 as fraction $\frac{25}{5}$ and dividing by fraction $\frac{1}{5}$. Subject made simplified operation of division into multiplication operation on the left side by writing *"* $x - 5 = \frac{25}{\cancel{5}} x \frac{\cancel{5}}{1}$*"*. The research subject was also able to perform multiplication operations on fraction. In this case subject did *kanselasi* numerator and denominator by the same number that was 5. Then Subject multiplied the numerator and the numerator, and multiplied the denominator and the denominator. Subjects looked doubtful when he wanted to continue the next step. Subject hesitate the completion step that he had written. It meant that the subject was reviewing the step of math task completion, and he finally made a decision by writing, " $x - 5 = 25$". In the next step, Subject summed both sides with the same number (summing up both sides with 5) so that the final result was 30. The subjects made the assertion by making a conclusion "so the number of cans before taking was 30 pieces". For the second completion, the subjects wrote down each step correctly.
Further subject rechecked the correctness of the answers he got as in Fig. 4 below.



Subjects checked the correctness of the answers by linking 30 cans with 60 liters of soy milk. Subjects wrote "$60: 30 = 2$". It meant that 60 liters of soy milk was distributed entirely into 30 cans. Each tin was filled with 2 liters of soy milk. $\frac{1}{5}$ of the can (2 liters) was $\frac{2}{5}$ liter. Subject wrote "$\frac{2x1}{5} = \frac{2}{5}$ ($\frac{1}{5}$ of the can)". After calculating the overall volume of soy milk $\frac{2}{5}$ $liter$ in 25 cans $\left(\frac{2}{5} \times 25 = 10\ liters\right)$ that contained as much as the volume of the soybean milk in cans $(5 \times 2 = 10)$, the subject concluded that the answer 30 cans was true.

V. CONCLUSION

Reference [10] states that there are three things related to the knowledge of mathematics, namely mathematical operation, mathematical concept and mathematical idea. The mathematical operation is the process of managing and manipulating mathematical information in meaningful ways that support and build on the ideas and concepts of mathematics. Mathematical concept is theoretical, systemic, and generative while the idea of mathematics was derived from one or more of conceptual understanding, the establishment of relation between the conceptual understanding and the formation of new ideas or applications. Students who are able to think *outside the box* are the students who are able to perform mathematical operation correctly to obtain different completion ideas, and different ideas generated use the size of the students themselves. In this research, the research subject used logical reasoning to get a precise mathematical task completion.

Referring to the results of the study, the following is the Description Table of thinking outside the box of students in solving a math assignment using the exploration, ideas generated, and justification.

TABEL 1. THE DESCRIPTION THINKING OUTSIDE OF THE BOX

Exploration phase	• Understand the problem statement by formulating information on mathematical tasks and the objectives to be achieved. • Subjects made markers on the problem statement "(1) Iswanto only needs 5 tin cans to make other cans fully filled; (2) The five empty cans were removed; (3) In fact, the content of each tin at present added exactly $\frac{1}{5}$ from the volume of the can before." • Subjects interpreted the problem statement marked by making a description of the problem situation by writing "5 cans for = all the cans" and "$\frac{1}{5}$ part of can is unfilled".

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ME – 72

Student's Self-Efficacy In Mathematics

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Abstract—, Cognitive and affective aspects simultaneously are very influential in student's achievement. One part of the affective aspects which play an important role in learning mathematics is self-efficacy. The purpose of this study was to analize self-efficacy in mathematics of students. The population were all students from Department of Mathematics – Mathematics and Sciences Education, Teacher Training and Education Faculty, University of Lampung. The samples were students who take Statistic course in odd semester, academic year 2015-2016. The study was done in two classes, namely class A which consist of 37 students and class B which consist of 37 students. The data analysis indicate that there is no significant difference of self-efficacy in mathematics (a) among students who have different prior knowledge (high, medium, and low), (2) between students in a different class (class A and B), (3) between male and female students, and (4) generally, all students have a positive self-efficacy in mathematics.

Keywords: *Self-efficacy in Mathematics*

I. INTRODUCTION

Effective learning happens when teachers know in depth the material to be taught and how to teach it. Therefore, teachers should analyze the material, choose which approach to use, choose a strategy and teaching materials, organize and build on the ideas, as well as the information and assignments for students. This means that effective learning requires lecturers to consider what is known to the student, clearly communicate to students, and inspire them to learn, think and communicate. All this is done because it is basically an individual's personal development needs are growing communicates and thinking ability, including the development of self-concept, self-learning setting, cooperation with others, as well as insight into themselves and others. The above suggests that lecturers need to prepare lectures and designing activities lectures, so not only the cognitive abilities of students are developing but also self-concept them, the ability to learn independently, ability to cooperate with others, as well as insight into themselves and others. All that will ultimately affect the learning process and results.

The relationship between cognitive and affective development until today is still a very big interest for educational research. Belief, Self-concept and self-efficacy are concepts that are often discussed in educational research. Rosenberg [19] states that self-efficacy is one component of self-concept. In a lot of literature, Self-efficacy is often associated with belief. Even some literatures mention it as self-efficacy belief. This suggests that self-efficacy is part of belief.

Regarding belief, [13] state that no single definition because it adapted to the purpose. Schoenfeld was quoted as [13] saying by [3] states that "Belief systems are one's mathematical world view, the perspective with the one approaches mathematics and mathematical tasks." [11], states that belief is a simple statement, consciously or unconsciously as part of what someone said or did, usually preceded by the phrase "I believe".

[21] states hat a number of the unique nature of the construct of self-efficacy are (1) self-efficacy more involved ratings a person's ability to perform activities rather than personal qualities such as a person's physical characteristics or psychological traits. Students assess their ability to meet the demands of a given task, not who they are or how they feel about themselves, (2) the belief that the multidimensional efficacy.

Definition of belief according to Schoenfeld above is special because it includes confidence in the nature of mathematics and the mathematical tasks. Another definition of belief proposed by [7], which is the way, we think about something in or around us. So that mathematical confidence can covers the subject of mathematics or the things that happen to themselves and their surroundings. In line with the opinion of [7], [18] state that mathematical Belief (faith) is a condition of cognitive structure of a person with respect to his views on his ability, mathematical objects, the process of learning mathematics, and mathematical usability. Cognitive structure relating to Belief (faith) in mathematics is hidden inside the person, but symptoms usually appear when he did the mathematical task, interact with the classroom environment, or respond to any stimuli.

Definition of self-concept stated by Gómez-Chacón was quoted as saying by [4], the self-concept refers to a person's picture of him about how he felt and appreciated in the context of mathematics learning. [12] states that the self-concept of students that studying mathematics to be structured as a sub-structure derived from the structure of beliefs. Shavelson [14] classifies self-concept in children and adolescents into two parts consisting of seven dimensions: academic self-concept (language, mathematics and general knowledge) and self-concept non-academic (relationship with parents, relationships with peers, ability and physical appearance).

Some research on affective aspects, among others, performed by [6] who found that among students aged 11 to 12 years old, female students showed higher anxiety and lower self-concept than male students. High anxiety and low self-concept correlated significantly with lower scores on tests of mathematical creativity. Research Plucker & Stocking was quoted as saying by [5] suggest that in the development of academic self-concept there is no significant difference between students who are strong mathematical, verbal ability or both. It has been tested by measuring the achievement of mathematical models is easy to use on a group of students. Some studies indicate that there is a positive and significant correlation between self-efficacy beliefs of students and their academic performance. Some research also suggests that the belief about themselves related to a person of success in mathematics [5]

Self-efficacy (SE) is defined as a person's judgment about his ability to achieve the desired level of performance or determined, which will affect the next action [2]. According to [22], SE is a personal judgment about a person's ability to organize and implement the work program in achieving its intended purpose, and he tried to assess the level, generality and strength of all the activities and contexts. Thus, the SE is one person's opinion regarding the ability to perform a particular activity. SE reflects how confident the students about his ability to do a specific task, so that the high someone's SE on specific parts yet ensure the high someone's SE on the other part. SE indicates how strong a person's belief that they have the skills to do something; they can be assured that other factors will make them successful.

[8] state that the SE also affect one's choice in setting behavior, the number of their efforts to complete the task, and the length of time they persist in the face of obstacles. Finally, SE affects a person's emotional reactions, such as anxiety and distress, and mindset. Thus, individuals with lower SE against certain tasks more thinking about their personal shortcomings rather than thinking about completing a task, in turn, will hamper the successful completion of the task.

According to [22], Self-efficacy beliefs will keep students motivated to learn through the use of self-regulation as a process of goal setting, self-monitoring, self-evaluation, and strategies used. This is in accordance with the opinion of [2] which says that the SE which is a central construction that will affect a person's decision-making, and affect the course of action. Someone will tend to run something when he feels competent and confident. Additionally, it will determine how much effort it does, how long he stayed when in trouble, and how flexible the unfortunate situation.The higher self-efficacy, the greater the effort, perseverance, and flexibility. SE also affects the mindset and emotional reactions. Someone with a low SE will easily give up, tends to become stressed, depressed, and have a narrow vision of what is best to resolve the problem. The high SE will help a person in creating a sense of calm in the face of difficult problems or activities.

According to Bandura [8], SE has three dimensions namely magnitude, strength and generality. Each of these dimensions gives important implications for someone's performance. Magnitude refers to the sequencing of the tasks according to level of difficulty. Strength refers to the belief that there is in a person that can be realized to achieve certain performance. Generality refers to the discretion of the SE owned by a person of that can be applied in other situations.

[9] states that the belief SE is not to make an assessment of one's ability objectively, but rather an assessment of what can be achieved with the skills a person possesses. In other words, the assessment of the SE is what someone thought about what he can do, not what he had. Furthermore it is said that the ratings SE is the product of a complex process of self-appraisal and self-persuasion that rely on cognitive processing on multiple sources of information efficacy.

According to Bandura, Perception SE can be formed by interpreting information from four sources: (1) An authentic experience: the source of the most influential, because of the failure or success of past experience will reduce or increase the someone's SE; (2) The experience of others: the source of the information necessary to make judgments about their ability; (3) social or verbal approach: an approach that is done in a way to convince someone that They does not have the ability to do something; (4) Psychological Index: is a physical and emotional status that would affect the ability of a person [20].

According to [15], research on gender with regard to mathematics has been done. This relates to the great curiosity of researchers to find out whether it is true that male students are better than girls in mathematics. [17] state that in some recent research (Fierros, 1999; Zhang and Manon, 2000; Johnson, 2000; Leahe and Guo, 2001; Ericikan, McCreith, and Lapointe, 2005) note that there is no difference significant achievement between boys and girls when they began to be introduced to mathematics. But the change toward a better showed by male students than female students change over time (Campbell, 1995; Mullis & Stemler, 2002).

Research on affective aspects and its relation to gender have been made. According to [10], learning programs to increase the average participation of women and equal rights in the improved performance have been developed, with varied results (Forgasz & Becker, 2005; Leder, Forgasz, and Solar, 1996). From the research it is generally reported that there is no difference, or there is difference that women are better. Therefore, many researchers say that the female students as a group are better than male student, especially in mathematics. Nevertheless, the research on students who follow AMC (Australian Mathematics Competition) shows that male students are superior [17]. Other studies related to gender and the development of understanding and confidence in mathematics at the university during the academic year in Turku Finlan until 2001 to 2003 done by [16], concluded among other things that the male students give better answers and more confident rather than female students. Under such conditions, encourage researchers trying to uncover the truth about the learning outcomes of gender be reviewed.

The following description is the result of research conducted to examine student's SE towards mathematics. This study aimed to get a picture of SE students towards mathematics, especially in Statistics class.

II. DISCUSSION

This study was an experimental study by applying problem-based learning involving two groups, in order to examine the self-efficacy of students towards mathematics. The population in this study was all students of mathematics department of Mathematics and Science Education - Teacher Training and Education Faculty, University of Lampung. The sample in this study is the third semester students who take a Statistics course in the first semester of academic year 2015-2016. The study was conducted in two classes namely class A which consists of 37 students and class B consist of 37 students.

In this research instrument used was a questionnaire scale of self-efficacy students are guided by the shape of a Likert scale with four choices: strongly agree (SA), agree (A), disagree (DA), and strongly disagree (SDA), without neutral choice. This is intended to avoid the hesitant attitude of the students to choose a statement filed. SE scale was conceived and developed with reference to: (1) the experiential aspect of performance, (2) aspects of the experience of others, (3) aspects of verbal persuasion, and (4) the psychological aspects of the index. To the experiential aspect of performance consists of 9 items, aspects of the experience of others consisted of 10 items, aspects of verbal persuasion consists of 9 items, and psychological aspects of the index consists of 11 items. Moreover scale SE is a statement that is both positive and negative by the number impartial. SE scale score calculation using the students scaling the response by [1]. By using this method score SA, A, DA and SDA of each statement can vary depending on the distribution of student response.

Tests conducted in this study are: (1) test of the difference between two average to see (a) differences in self-efficacy towards mathematics from students who have different prior knowledge (high, medium, and low), (b) differences in self-efficacy students from different classes (classes A and classes B); (2) an analysis of the SE scale scores to see whether the overall student has a positive self-efficacy toward mathematics. For the purposes of data analysis, students are grouped into three groups of initial knowledge of mathematics (High, Medium, and Low). Prior knowledge of mathematics (PKM) are based on mathematical comprehension tests given at the beginning of learning. Data on self-efficacy of students towards mathematics was obtained through SE scale questionnaire. Description of self-efficacy scale scores of students (SSSE) can be seen in Table 1.

The data in Table 1 shows that the average score of SE students with different PKM (high, medium, low) indicate different values, but the difference was not too great. Standard deviation value of student with medium and high PKM are more widespread than students with low PKM. The average score SE students from different classes (Classes A, Classes B) shows the values are different, class B has an average higher although the difference is not too great. Standard deviation value of student of classes B is

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more spread out than students of classes A. The average of score SE students with different gender (male, female) shows the different value, male students have a higher average although the difference not too big. Standard deviation value show that the data of female students seen more widespread than male students.

TABLE 1
DESCRIPTION OF DATA SE SCALE OF STUDENT BY PKM AND CLASS

Category		Max Score	x_{min}	x_{max}	$\bar{x}$	S	N
PKM	High	216	132	178	137.48	9.26	21
	Medium	216	126	161	140.94	9.28	24
	Low	216	121	153	141.23	9.15	29
Class	A	216	130	159	138.95	9.13	37
	B	216	121	167	140.28	9.25	37
Gender	Male	216	130	168	144.44	9.19	18
	Female	216	121	170	143.25	9.22	56
Totally		216	121	178	140.86	9.13	74

To determine differences in self-efficacy towards mathematics from students who have different prior knowledge (high, medium, and low), originating from different classes (classes A and B), and originating from different gender (male, female), then performed statistical analysis covering the distribution normality test, homogeneity of variance, and difference average test. Normality test data distribution of SE scale score using the Kolmogorov-Smirnov test concluded that the sample comes from a population that is normally distributed. The next test is homogeneity of variance student's SE scale score using Levene test concluded that the variance of the two sample groups (according to initial capabilities and by class) is homogeneous.

Furthermore, using t-test it is determine the difference between two groups of samples. Based on testing, it is known that SE scale score of students with high PKM and students with medium PKM was obtained t value = 1.249 and t table = 1.68. This means that the null hypothesis is accepted. Thus, it can be concluded that there is no significant difference in self-efficacy towards mathematics in students who have high PKM and medium PKM. Based on testing, it is known that SE scale score of students with high PKM and students with low PKM was obtained t value= 1.423 and t table = 1.68. This means that the null hypothesis is accepted. Thus, it can be concluded that there is no significant difference in self-efficacy towards mathematics in students who have high PKM and students who have a low PKM. To SE scale score students with medium PKM and students with low PAM, obtained t value = 0.114 and t table = 1.68. This means that the null hypothesis is accepted. Thus, it can be concluded that there is no significant difference in self-efficacy towards mathematics students who have medium PKM and students who have low PKM. To SE scale score of student from classes A and classes B, obtained t value = 0.622 and t table = 1.67. This means that the null hypothesis is accepted. Thus, it can be concluded that there is no significant difference in self-efficacy toward math at class A student and class B student. For male students and female student, obtain t value = 0.477 and t table = 1.67. This means that the null hypothesis is accepted. Thus, it can be concluded that there is no significant difference in self-efficacy towards mathematics among students male and female. Furthermore, to see whether the overall student has self-efficacy positively to mathematics, the impacts on the scale score SE. In this study, the analysis is done through four aspects that can affect self-efficacy by Bandura, namely: (1) Achievement of performance, (2) experience of others; (3) verbal persuasion, (4) Psychological Index. Distribution of students SE scale score towards mathematics are presented in Table 2.

Based on the data in Table 2, in general self-efficacy of students showed positive towards mathematics. It can be seen at the average score of students SE amounted to 3.625 and is larger than the neutral score of 2.875. Similarly, when viewed for each aspect SE. For the achievement of the performance aspect, the average score of students SE amounted to 4 and larger than the neutral score. Aspects of the experience of others, the average score is 3.5 and larger than the neutral score. For the aspect of persuasion verbal, the average score of students SE is 3 and larger than the neutral score. For the psychological aspects of the index, the average score of students SE is 4 and larger than the neutral score. Thus, both in general and for each aspect, the students have a positive self-efficacy toward mathematics.

TABLE 2
DISTRIBUTION OF SE SCALE SCORE

Aspect	Description	Number statement	Neutral Score	SE Sccale Score
Achievement of performance	Indicators of the performance capability based on previous experience	1 to 9	3	4
experience of others	Evidence based on competence and informative comparison with the results of others	10 to 19	3	3,5
verbal persuasion	Referring to the direct feedback / words of a teacher or older adults	20 to 29	2,5	3
Psychological Index	Assessment capabilities, strengths and weaknesses	30 to 40	3	4
Average			2,875	3,625

Based on hypothesis testing and analysis of the SE score is known that there are no differences in self-efficacy among students towards mathematics who have different prior knowledge of mathematics (high, medium, or low). This shows that all students who come from different classes or students with different gender have the same confidence in the statistic class. It also shows that the lecturer had given the same treatment in` the second class in Statistics class for students male and female. This results when analyzed more deeply through interviews to some students and the observations made, have indeed found that lecturers give equal treatment to both classroom. Analysis on the self-efficacy scale scores showed that students in general have a positive self-efficacy toward mathematics. This is an important asset to obtain better learning outcomes, because a person's belief that he was able to do something specific task will influence its success to complete the task.

III. CONCLUSION

As mandated in the curriculum, the affective aspect is an aspect that should also be considered in the study. But compared with the cognitive factors, affective factors increase more difficult and time consuming. The fact can be seen in this study that there was no significant difference in self-efficacy towards mathematics in students who have different prior knowledge of (high, medium, and low), students from different classes (classes A and B), and students with different gender (male and female). Analysis of self-efficacy scale scores show that both in general and for each aspect self-efficacy, students have positive toward mathematics. This is a provision that benefit students. Because self-efficacy that will positively affect the students in decision-making, and affect the course of action. Someone will tend to run something when he feels competent and confident. Additionally, it will determine how much effort it does, how long he stayed when in trouble. Someone with higher self-efficacy have great effort, perseverance, and flexibility.

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Autistic Gesture in Recognizing Geometrical Shape

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Abstract— The aim of this study is to describe the autistic gesture in understanding the shape of geometry. Data collection was done during the process of mathematical learning in progress by recording the activity of teachers and students using audio-visual cameras. The collected data were analyzed exploratively. The results of the study revealed the autistic gesture in understanding the shape of geometry in the category discrepancy gesture. The gesture indicates a mismatch movements or facial expressions when observing, pointing, and uncovering/recalling the objects being observed.

Keywords: *gesture, autistic, geometry*

INTRODUCTION

American Psychological Association [1] defines autistic as a developmental disorder that occurs in children who are self-closing conditions. These disorders cause children to have limitations in terms of communication, social interaction and behavior. Based on this theory, it is in relation to the learning process, students with autistic can be defined as students who have developmental disorders of communication, social interaction and lack of flexibility in thinking and behaving.

Sussman [2] outlines that in learning process; students with autistic are easier to learn (to understand the learning material) through visual media, so learning which use instruments as figurative media is become the chosen options for the teachers. These instruments may include images, posters, toys (balls, blocks) and others. Based on Sussman, the process of mathematic learning for autistic can be started from the nature of concrete, using drawings or concrete objects around the students, such as learning about geometry, teachers can start the learning by introducing form of geometry with variety of concrete objects such as dice and cardboard the same shape with the shape of a cube. Students are given the opportunity to perform actions such as observing/seeing, feeling, and reveal/call geometric shapes on concrete objects that are observed, or students can be taught to identify or classify objects according to similarities in character. Action is one of the gestures (gesture), as revealed UEFAP [3] that the gesture is an act which sends visual cues.

According to Freedman (Shein, [4]) "gesture is a facilitator of verbal expression". Supporters of this view argue that the gesture is intended to achieve a more adequate verbal expression. In addition McNeill [5] says that "the movement of the hand and body movement can be regarded as a gesture". This was also confirmed by Hostetter and Alibali [6], Gallagher [7], McNeill [8], Nunez, [9], Gibbs [10], Alibali and Nathan [11] which says that "person who uses his/her body (ie gestures) to reveal knowledge, thinking, and knowledge must be bonded/integrated with the body ". The body parts which visually most expressive are face and hands (Kumar, [12])

Autistic gesture in mathematics learning comes naturally and different between a student and the others. This is due to different spectrum among students, as revealed by Lord [13] that "autistic spectrums affect various aspects of thinking and learning". Gesture accompanied by remarks upon completing a math problem can arise spontaneously and simultaneously, and according to McNeill [8] "that accompanied a greeting gesture can help shape the mind". Tots [14] revealed that "many children with autistic are visual thinkers". This statement indicates that students with autistic may think or process information by using pictures, and thinking processes is termed a visual thinking. Tots ([14] added the visual thinking occurs when students think to create illustrations, drawings or play a variety of real objects in the vicinity.

This study focused on identifying problems and described appropriate with the autistic gesture performed at the time of doing the task. Form task is to identify problems of geometrical shape by using concrete objects. For example; a teacher introduces geometric shapes "cube" with a picture showing the form of "cube", then shows images of concrete objects which is the same shape as a form of "cube".

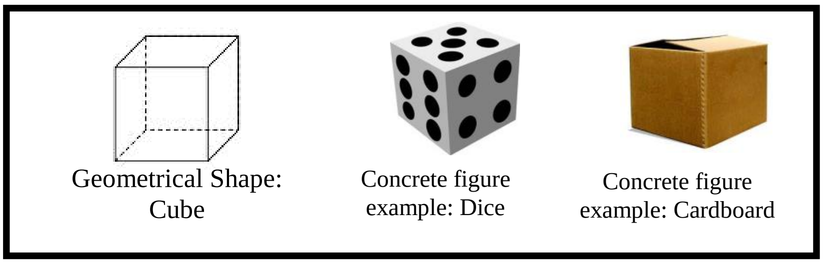


Figure 1. Example of Geometrical Shape along Concrete Object

Figure 1 is the initial activity of the student before tackling the task to identify the appropriate geometry on concrete objects. In this activity the teacher introduces geometric shapes by using the drawing, further shown some examples of concrete objects shaped like the geometry. Student's activity are directed to listen, observe and recognize the image of teachers appointed, so that when the work task student can identify appropriate forms of concrete objects specified geometry.

Identify the problem (determine or establish the identity of geometric shapes in concrete objects), is the ability to find/search for, retrieve or get back information about the object being observed specifically. Identifying the problem is done through activities create the perception, analyze, and determine the identity. Perception is the act of composing, recognize, and interpret sensory information in order to provide an overview and understanding of the observed object. Empirically students with autistic create the perception of how to interpret the real object is seen/ observed or holding. This is in line with the expression Solso [15] that perception refers to the interpretation of the things seen, heard, felt, or experienced more than sensory stimulation. Further sensory events are processed/analyzed according the knowledge of students about the observed object, then determine the identity of the object.

Methodology

The main instrument in this study are the researchers themselves, because the researchers themselves who collect data through recording, or observation/observation (Creswell, [16]). To strengthen the research data required support, which is a tool used to collect data about the austistic gesture in recognize geometrical shape, among others: (1) The audio-visual camera, is used as a tool to record a gesture that appeared during the learning process, and (2) are arranged Task Sheet more varied according to the materials that have been studied are familiar form concrete objects.

Data collection was done during the process of mathematical learning by recording the activity of teachers and students using audio-visual cameras. The collected data were analyzed exploratively.

Result and Discussion

Explanation and data analysis include the description and the structure of autistic gesture. Analysis description structured systematically as follows:

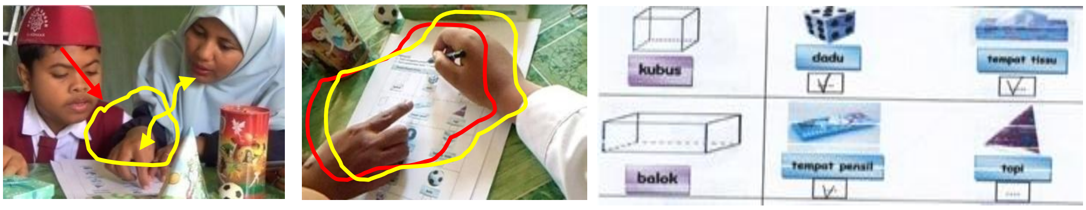
1) Choosing a collage of video footage representing alleged representative for analysis.
2) Develop a transcript of the interaction of the teacher and the subject is based on pieces of image points (1). Transcripts narrated into "Record Box" which contains conversations of teachers and the subjects in the form of speech or gesture (the expression or hand movement).
3) Analyzing "Recording Box", i.e. narrative thinking processes that appear based on points (1) and (2).

Each piece of the picture is given "squiggle line" with different colors, and each hinted meaning. A straight line with a red arrowhead indicates the subject is being observed, while yellow indicates the teacher is watching. Not straight red line shows the subject of sound whiles the yellow teacher sound/uncovering/instructed. Curved lines or a red circle indicates the student gesture (hand gestures or face expressions/view), while yellow indicates gesture teachers.

"Box Recording" is written in two different kinds of writing, the writing is printed using italic typeface (font italics) shows the interaction is done by issuing voice/speech both teachers and the subject, while writing printed with letters upright (not italic) shows interaction is done with motion compensation (hand or face expressions, no sound), if there are in the sign posts "(...)", then tells the movement cues that accompany the interaction.

At the beginning of the learning process, the teacher introduces geometric shapes such as cubes, blocks, balls, and tubes using concrete objects and sees the similarities in the pictures on sheets task that will be

done. This process is the first step that teachers before students work on the task. If the student has understood the teacher's explanation, then the next step the teacher guiding students working on task.
Next is exposure data and mathematical thinking process analysis based on the results of exploration gesture learning through video recordings. Analysis was performed on two students with autistic.



Teacher : Which ... which is shaped like a cube? (Pointing to the picture "dice" and "pencil")
Rico : This.... (Pointing mark "√")
Teacher : which one? (Ask Rico to point the concrete objects shaped like a cube)
Rico gave a "√" in the picture "dice"
Teacher : what about things shaped like a beam...?
Rico : beams ... (pointing to pictures "hat" then about to give the sign "√" on space)
Teacher : This one, selected here ... which one? (Pointing to the picture "beam", "pencil box" and the "cap")
Rico waving a pencil in space image "cap"
Teacher : Which picture? This is yes ... dear .. you know, this isa beam, two pictures, between these two beams are shaped like where? (Directing the focus, Rico observe illustration designated by teacher)
Rico pointed to the picture "Tissue" in the image cube group
Teacher : that here ... (pointing picture "pencil" and "cap" on the beam group)
Rico : This...? (Pointing to the picture "pencil" and mark "√" on its space)
Teacher : he'e (observe Rico)
Rico gave a "√" in the picture "pencil" in a cube group
Teacher : This you know...! (Pointing to the picture "pencil")
Rico gave a "√" in the picture "pencil"

Figure 1. Interaction 1 in Identifying Geometrical Shape

Figure 1 is the interaction of teachers and Rico at the time of identifying the shape of "cube" and "beam". Identification form "cube" made in the image concrete objects "dice" or "a tissue", while identification form "blocks" made in the image concrete objects "pencil" or "cap". The initial process begins with the teacher explains the task briefing. Rico asked to provide the identity of the one picture "dice" or "a tissue" that looks just like "cube". Response from Rico listening to the explanation of teachers and observe the image on the sheet designated task. Master points to picture "dice" or "place of tissue" that looks just like a cube. Rico responds to hand gestures by pointing the symbol "√" in the task instructions, and without pointing to one picture instantly identity mark "√" in the image space "dice". Gesture indicates Rico can perceive the form of "cube" correctly because doing matching gesture. Next comes a discrepancy gesture select images "pencil" or "cap" that looks like "beams". Hand movements Rico was about to give the sign "√" in the picture "cap" but hesitated, so the teachers try pointing alternately directing the picture "beam", drawing "a pencil", and picture "cap" that Rico can easily see similarity shapes. Rico expression instead turned his attention to observe the image "Tissue" in the "cube" and direct his movements' identity mark "√" on its space. Discrepancy gesture indicating Rico distraction on spatial relations (location / position) perceives forms "beams". Hand movements to give the sign "√" in the picture "a tissue", meaning that Rico can repeat ideas visually perceive "beam" as image "Tissue", but not in accordance with the option specified image. Teacher finally asked to give personal mark "√" in the picture "pencil" as a sign that his idea was right but the wrong choice of picture.

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Identification is then performed on geometry "ball". Activities are shown as Figure2.

Teacher : If this one .. this ... .. (pointing the drawing of a ball)
Rico : ball ...! (refer to picture the designated teacher, then about to give the sign "√" in the picture "cap")
Teacher : look at this one .., there are "marbles" and "canned milk", this shaped like a ball which one? "marbles" or "canned milk?" (directed Rico to focus observing illustration designated by teacher)
Rico : "cans of milk" (while giving the sign "√" in space)
Teacher : that looks like ... try this one? (trying to stop Rico)
After Rico mark "√" in the picture "canned milk", his hands moving about to give the sign "√" in the picture "hats"

Figure 2. Interaction 2 Identify Geometrical Shape

Figure 2 is the interaction of teachers and Rico at the time of identifying the shape of the "ball" in the figure concrete objects "marbles" or "cans of milk". Master points to pictures "ball" then Rico call picture "ball" designated teacher but accompanied by hand gestures toward an image "cap" on the "beam". Discrepancy gesture indicating Rico still distracted on spatial relations, so the difficulty repeating ideas visually perceived forms "balls" on the choice of concrete objects specified image. A teacher distracts Rico in the picture "marbles" and "canned milk", then asked him choose the same image with a "ball". Discrepancies arise gesture, expression Rico responded by calling "canned milk". At the time of his movement wanted to give a sign of identity "√" in the image space "canned milk", the teacher tried to stop the movement of the hand and led him to back Rico observe the image. This condition indicates that the teacher's role is dominant directing Rico in order to identify the forms of concrete objects that resemble geometric shapes "ball". Rico hand movements still give a "√" in the image space "milk cans", and even tried to give the sign "√" in the picture "hat" again, but the teacher stops his act then giving explanation that not all the images are marked. Discrepancy gesture indicating Rico had distraction on observation to perceive the form of "canned milk", so he ignored the image "marbles" that looks just like "ball". Identification is then performed on geometry "tube". Its activity is shown as Figure 3.

Teacher : see ... tube (picture of tube repeatedly pointed)
Rico : tube ...! (follow the teacher called the tube)
Teacher : this same shape as the building is tube, "piggy bank" what "ball" (pointing repeatedly drawing the tube, then pointing alternately drawing "piggy bank" and picture "ball")
Rico : piggy bank (with a mark "√" in the piggy bank image)

Figure 3. Interaction 3 in Identifying Geometrical Shape

Figure 3 is the interaction of teachers and Rico at the time of identifying the shape of the "tube" in the figure concrete objects "piggy bank" or "ball". Teacher points to picture "tube". Appears matching gesture, Rico responded by repeating the words of teachers call "tube" in the designated image repeatedly. Teachers pointed repeatedly while providing noise suppression, aims to focus Rico can observe the image. The teacher directs select images "piggy bank" or "ball" shaped like a "tube", an expression Rico responded by calling "piggy bank" and then hand movements mark "√" in space.

The process to identify the geometric shapes by using concrete objects that done by Rico tend to experience a discrepancy gesture, meaning its happen a distraction on observation so that Rico difficult perceive, analyze and establish the identity of geometric shapes in the concrete objects image. Distraction triggered by imbalances of the motorist on observing and pointing, because the emotional (strong confidence) against his conviction can identify problems. Rico is very difficult to repeat the visual idea of the form of concrete objects.

The structure of autistic individuals think that doing partially processed can be shown as Diagram 1 below.

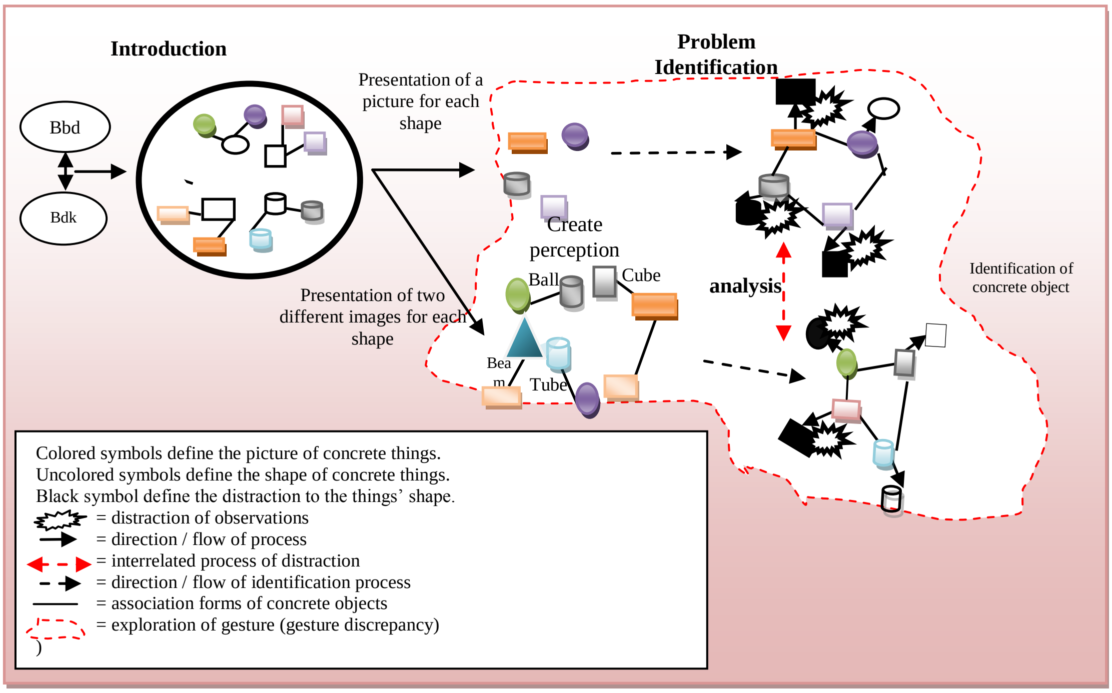

Diagram 1. Thinking Structure of Rico Identifying Problems (Mustafa, 2015 [15])
(There is a discrepancy gesture)

Furthermore, it can be concluded that individuals perceive objects based on visual observations and tend to be affected by the instability of mood and the circumstances surrounding it. This is in line with the statement Solso [16] that perception refers to the interpretation of the things seen, heard, felt, or experienced more than sensory stimulation. Further sensory events are processed/analyzed according the knowledge of individuals about the object observed. Perception by individuals with autistic is an interpretation of sensory information that allows people aware of the various objects and situations with meaning. Lerner [17] reinforces this analysis by defining perception as the process of organizing raw data is achieved through a variety of senses and interpretations of meaning, while the perceptual information is improvement of sensory information.

In addition to creating the perception, individuals with autistic also perform the association scheme by way of trying to repeat previous information by observing a variety of pictures or other objects that can represent the object being observed. In this way reinforced Powell [18], which outlines that in mathematics, individual can use the scheme to organize the information by using a variety of images or diagrams that can represent the basic structure of the type of problems encountered. Association scheme by individuals simultaneously and sequentially, indicating the ability of individuals to make abstraction of the mathematical objects encountered, as Marshall [19] reveals that the scheme contains an abstraction.

Conclusion

Autistic gesture when identifying problems shown as follows:

1) Facial expressions focus to hold objects observation with irregular hand movements move, taking out the words that elusive (appears echolalia), then the view slowly turns observing a variety of objects that are interrelated but difficult to maintain his observations. This gesture indicates individuals having difficulty selecting or process information so that individual processing of sensory

information by partially corrects (no object designated but not in accordance with the object being observed). This gesture by the individual at the time of making the perception.

2) Furthermore, observed objects without face expressions that have been perceived, but his observations did not last long because of his active continuously. If suddenly the idea/notion of the object being observed, then the individual immediately respond very quickly move the hand pointing object, calling the identity associated with the observed object, but this movement is accompanied by accentuation echolalia. Echolalia break the concentration (being the trigger of distraction), so that the identity of the object partially done correctly. This gesture by the individual at the time to analyze and determine the identity. Individuals experiencing discrepancy gesture.

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The Effectiveness Of Teaching Materials Integrated Local Culture Aspect Of *Massenrempulu* In Mathematic Learning

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Abstract— The background of this research showed the use of media is needed to help students learn mathematics concepts that relate directly to the students, namely artifacts and language that used in their region. School is a place where culture is associated because learning process as habitual process. It enable mathematical concepts embedded in cultural practice. The implication of cultural characteristics in mathematics learning, it can be seen on the topic that is often referred *ethnomathematics.* To ease the implementation of learning in the schools, one of ways can be applied is teachers' creativity which very needed in designing teaching materials to create active learning atmosphere, comfortable, and not in spite of their cultural characters including in the use of artifacts and local language in their region. This study was a quasi experimental design which aimed to find out whether the learning process that use of teaching materials integrated with local culture aspect of *Massenrempulu* was more effective than learning without the use of teaching materials. The data collecting of this research used instrument in the forms of learning achievement test on the materials triangle and the observation sheet students' activity. The data analysis of this research implemented statistical descriptive and inferential analysis. The analysis showed improvement of the students learning achievement, and the students learning activeness of experimental class was more active than control class. It can be concluded that the learning process by using teaching materials integrated with aspect of local culture of *Massenrempulu* was more effective.

Keywords: *Effectiveness, teaching materials, culture of Massenrempulu, mathematics learning*

I. INTRODUCTION

Suharsimi (2003:10) stated that new educational systems now widely popularized in western is study alone system. Study alone able to be applied by studying a package of learning. It can be modular form or the others package learning. As a reason for the appearance of this system is a great recognition of the individual's ability.

The fact that they often face is many students still find difficulties in learning mathematic. Some causes of these difficulties included: math does not seem related in daily life, a monotonous way from abstract concept to the concrete do not make students loved learning, and learning process still apply teacher centered learning. In the other hand, one of the things that make student find their problems in learning/understanding the math is there is no connection between the experiences of students daily life and formal mathematics. Hudoyo (1990: 4) stated that mathematics concerned with ideas/abstract concepts which is arranged hierarchically and its reasoning deductively. So that in mathematics studying should be a continuous process and should not be interrupted. From some causes that mentioned earlier, there is other fact became the cause that is the language used.

In relation with these things, we must view a variety of alternatives and innovations in order to improve students' math skills. One key of the elements is the improvement of teaching in schools by increasing the portion to reason particularly, solve problems, argumentation and communicate through more contextual teaching materials. Mathematic learning has to connect with contextual issues that exist in society. It should be involved cultural context inherent and manifest students themselves, student's perception will be wider in hopes of driving active events and mental work students in the development process of students' reflective, discuss, asking, debate, delivered over different interpretations of students in looking at the problem, so that the process of formation of mathematical knowledge departs from what has been previously owned by the students and will easily resolve various problems.

Based on observation, there are students who do not understand if using Indonesian monotonous. One effort to overcome this difficulties is using "students centered learning", namely building concepts, principles or procedures are needed, where the teacher just as a facilitator and students are free to spend their ideas and enjoy the learning process. To apply this learning system, it requires the appropriate learning resources. Thus, teachers are expected to develop teaching materials as a source of learning.

Materials can be written or unwritten. But, the teaching material that the author means is the materials in written form which are compiled by teachers systematic that is integrated with the local aspect culture, and it refers to the achievement of basic competence then the instructional materials distributed to the students. Therefore, teaching materials have to be selected appropriately in order to help students in achieving the optimum standards of competence and basic competences.

II. LITERATUR REVIEW

A. *Teaching Materials*

Mbulu and Suhartono (2004: 87) stated that teaching materials is a learning content that contained in the book that written by a teacher or other authors for the benefit of learning. It is further mentioned that the teaching materials are designed and developed based on the principles of good teaching that will help students in their learning process, help teachers to reduce the time of the presentation the material and reproduce teachers coaching time to students, assist schools in completing the curriculum, and achieve learning objectives with the available time.

Based on the Ministry of National Education (2008: 11) concluded that the teaching materials divided into four categories such as printed materials (printed) like handouts, books, modules, and student worksheet. Teaching materials through listening (audio) such as tapes, radio, phonograph records, compact disc and audio. Teaching materials are through watching and listening (audiovisual) such as video, compact discs, and films. Interactive multimedia for teaching materials (interactive teaching material) such as CAI (Computer Assisted Instruction), compact disk (CD) multimedia interactive learning and web-based teaching materials (web-based learning materials).

Teaching materials involved two words that are teaching and materials. According to the University of Wollongong NSW 2522, AUSTRALIA on its website, Web Page last updated: August 1998, teaching is defined as the process of creating and sustaining an effective environment for learning (implementing learning is defined as a process of creating and maintaining an effective learning environment). Paul S. Ache further argued about the material, consists of: books can be used as reference material, or they can be used as paper weights, but they can not teach (the book can be used as reference material, or can be used as written material that have weighs) (Purnomo, 2010: 15).

The objectives of teaching materials such as: (1) providing teaching materials in accordance with the demands of the curriculum and considering the needs of the students, the teaching materials should be appropriate to the characteristics and settings or social environment of students, (2) assist students in obtaining alternative materials when the text books are sometimes difficult to obtain, and (3) make teachers are easy to do learning process. The teaching materials may include handouts, books, student worksheet (LKS), modules, brochures or leaflets, wall chart, photos/pictures, model/mock-up. In preparing the materials, something that should be considered is the title or the materials that are presented should be cored Basic Competency (KD) or subject matter that should be achieved by the students.

Implications of cultural characteristics in mathematic also can be seen on a topic that is often referred as ethno mathematic. Ethno mathematic initially pioneered by Ubiratan D'Ambrosio in 1985. On one level, ethno mathematic called as a math in the environment or math in the community. In another level, ethno mathematic is a special way which is used by a particular cultural group in classifying, sorting, counting and measuring (activities of mathematics). Furthermore, the purposes of exploiting some local involves some aspect, one of them is "Massenrempulu" especially those on the artifact and the local language of the area is expected to help students for do not forget the characteristics of their culture.

B. *Culture of Massenrempulu*

Culture = *cultur* (Dutch) = *culture* (English) comes from the Latin meaning *colore* means process, working, nourish and develop especially cultivate the soil or farming. Based on those meanings, the word of culture can develops as the sense of power and human activities to process and changing nature. According Widagdho (1991: 18) stated that from the point of Indonesian, culture come from 'sansekerta" means *buddhayah* which is the plural form of *buddhi* which means the mind or intellect.

Culture in society is often defined as *the general body of the arts*, including literary arts, music, sculpture, plastic art, philosophical system or the beautiful parts of human life. Finally, the conclusion is obtained that culture is the production of the human to attain the perfection of life. Everything that is created by humans both concrete and abstract, that is a culture.

The location of *Massenrempulu* is very rich in various art and tradition. It can not be denied that art, culture, and customs are giving contribution to building whole Indonesian nation including building and welfare of all, especially in Enrekang. But, all of it don't get more attention from the society. In fact, the diversity of art, culture and customs are owned by Enrekang very much. Unpredictable, Enrekang are the only areas in South Sulawesi which has five kingdoms (http://enrekangkota.wordpress.com, 2009).

As a motto from ancestors who have been lived in the Enrekang area to unite the society is: *mali siparappe, re'ba sipatokkong, malilu sipakainga,* means that: drifting must be landed, fall should be upheld, and forget shall be reminded (Batjo, 1995: 12). The purpose of the motto is help one strengthen of the power, enforce the state with the people in order to achieve a happy and prosperous together.

Implications of the characteristics of culture in mathematics (Etnomathematics) are some examples of the cultural heritage that can be used in mathematics, including artifacts and a local language *Massenrempulu*. One artifacts that can be used include traditional homes. The portions of the traditional home can be used to explain the concept of plane. Likewise with the ornaments founded in traditional home which is seen some form of planes.

Besides traditional homes, there are also some aspect of culture which is become mainstay in Enrekang, it is from culinary such as: *dangke, baje kotu, baje karrang, baje janggoreng, dodol malino, deppa te' tekan, and nasu cemba.* Besides famous with its coffee which have been penetrated to overseas, Enrekang also became the only region producing local cheese that is often called *dangke* as a traditional foor made from cow's milk that is frozen. In addition, endangered heritages are bamboo musical instrument, this instrument is familiar with bass music with the way to play do not get hit or beaten.

C. Effectivenes

Effectiveness in English means efficacy. The effectiveness according to Slavin (2010) consists of four indicators: (1) the quality of learning, (2) the suitability of the learning level, (3) intensive, and (4) time. Schulman (Nurdin, 2007: 105) suggests the effectiveness of two types of learning, included (1) the effectiveness of correlative and (b) the effectiveness of the normative. The effectiveness correlative is the effectiveness assessed as a function of measures of academic achievement. In other words, a study became effective when correlated or in accordance with the desired result. While the normative effectiveness is comparing the results of the implementation of learning with a model or ideas about good learning which are derived from a theory. The criteria of effectiveness of normative used correspondence as the test tool, not a correlation. So, a study became effective when it corresponds suitable with standard procedures that developed theoretically.

Based on the descriptions above, academic achievement or student learning outcomes is one of the aspects of learning effectiveness. The other aaspect is is student activities and student responses.

Sudjana (1989: 38-39) stated that, teaching success can be seen from student achievements, and of course expect that all of the results obtained a system of values form (value system) which can form the personality of students, giving color and direction in all actions. Hamalik (2006: 30) the results of learning is when a person has learned to expect a change in behavior in a person, for example from unknowing to knowing, and from do not understanding will understand. Good learning outcomes must be comprehensive means not just the acquisition of knowledge solely but is also evident changes in attitudes and behavior in an integrated manner. Big Indonesian Dictionary (2003: 895) argues that achievement from learning outcomes that have been achieved or done.

Based on some opinions that mentioned earlier that the result of learning mathematics in this study is an indicator of the level of students' understanding of mathematical concepts or materials which has been taught, causing a change in attitude and behavior in an integrated manner. These changes occur not because of maturity of the effects of learning activities that acted in the learning process.

D. Hypothesis

Based on literature review and framework which has been explained above, so the hypothesis in this research is the students' achievement of mathematics learning which has been taught by integrated teaching materials by aspect of local culture of *Massenrempulu* is more effective than the achievement of students which has been taught without using teaching materials.

For the statistical purposes, the hypothesis of this research as follows:

$$H_0 : \mu_1 \leq \mu_2 \ \textit{opposite} \ H_1 : \mu_1 > \mu_2$$

With

μ_1 : The average of learning achievement which has been taught using integrated teaching materials by aspect of local culture of Massenrempulu.

μ_2 : The average of learning achievement which has been taught without using teaching materials.

III. RESEARCH METHOD

A. Types of Researc

This research is quasi experiment which aims to know whether the learning by using integrated teaching materials by aspect local culture of *Massenrempulu* is more effective than the learning without using teaching material. Variable in this research namely independent variable and dependent variable. Independent variable is the learning treatment by using integrated teaching materials by aspect local culture of *Massenrempulu* as experimental research and independent variable is students' mathematics achievement that will be obtained by the researcher through mathematics achievement test.

B. Research Design

The research design that will be used is *Randomised Control Group Design*. This design will put experimental class and control class randomly so both classes are same and the treatment for both classes will determine the difference.

C. Definition of Variable Operation

In order to avoid misinterpretation in understanding variable so the definition of variable operation that will be used in this research as follows:

- Integrated teaching materials by aspect of local culture of *Massenrempulu.*. Integrated teaching materials by aspect of local culture of Massenrempulu is written materials that organized by teacher systematically which containing materials that support the achievement of competence standard and basic competence which the materials will be integrated with local culture aspect of *Massenrempulu* that focus on artifact and local language. The materials will be given to students before learning process so the students can know and learn the materials that will be discussed in each meeting and the students can repeat the materials at home so the learning process will be more effective and efficient.

- Effectiveness. The effectiveness of learning can be measured from comprehension or students' learning completeness and students' activeness in learning process. The criteria of students' learning completeness can be seen from learning outcome by give the student exercise, students who have been reached the KKM are pass and if 85% already achieved by students through KKM, so the class has been reached learning completeness.

D. Population and Sample

Population in this research is the seventh grade students of SMP Negeri 1 Anggeraja that consists of seven classes. Sampling will be taken from population members which conducted by using technique of *Random Sampling.* The sampling method doing because the population member is homogenous so the sample that selected can represent the population. The steps for sampling as follows:

- Among all students from seventh grade of SMP Negeri 1 Anggeraja which consists of seventh classes, two classes has been choose and will determined randomly which one will be experimental class and control class.

- Next, the learning treatment will be given to experimental class by using integrated teaching materials by aspect local culture of *Massenrempulu* and control class without using teaching materials.

E. Technique of Data Collection

The data from this research gained from learning process and learning outcomes. Data of learning process gained through observation from student activity in learning process. Data of learning outcomes gained by give learning achievement test namely *essay*, the test will be conducted after experimental class is over. In order to avoid misappropriation in finishing the test, the test for each class will be conducted at the same time.

F. Techniques of Data Analysis

The collected data will be analyzed quantitatively. Techniques of data analysis for research result that will be used, namely:

- Analysis of Learning Completeness. Analysis of learning completeness be used to know whether the learning by using integrated teaching materials by aspect local culture of *Massenrempulu* is more effective to seventh grade students of SMP Negeri 1 Anggeraja. The scores obtained by students through learning achievement test will use to determine individual completeness and students classical completeness on standard of competence that should be mastered by students. Individual completeness (students) is determined with the formula:

$$N = \frac{S_i}{S_t} \times 100$$

With:

N = Individual learning completeness
S_i = Total scores achieved by students on all indicator test
S_t = Total score from all indicator test

The class will pass the completeness if there are 85% students in that class are pass the KKM. The completeness of learning in the class will be presented by using percentage with the formula as follows:

$$Study\ Completeness = \frac{The\ number\ of\ students\ who\ have\ been\ pass\ the\ study}{The\ number\ of\ all\ students} \times 100\%$$

- Analysis of Descriptive Statistics. By using the average frequency table, percentage, and standard of deviation to describe the respondent scores from each research group. The structure of analysis organized based on Depdikbud (Darmawati 2006: 19): level of mastery 0% - 34% is cathegorized as very poor, level of mastery 35% - 54% is cathegorized as poor, level of mastery 55% - 64% is cathegorized as fair, level of mastery 65% - 84% is cathegorized as high, level of mastery 85% - 100% is cathegorized as very high.

- Analysis of Inferential Statistics. Analysis of inferential statistics will be used to test the research hypothesis. In this case, the researcher will use one line variant or test-t as follows:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

s^2 is combined variation by using the formula below:

$$s^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

(Tiro, 2000: 234)

Specification for the formula above: $\bar{x}_1$ = Mean score of experimental class, $\bar{x}_2$ = Mean score of control class, n_1 = Total number of subject in experimental class, n_2 = Total number of subject in control class, s^2 = Standard of deviation combination, s_1 = Standard of deviation in experimental class, and s_2 = Standard of deviation in control class.

There will be requirement of analysis before doing test-t namely (1) normality test, and (2) population variant homogeneity test.

IV. RESULT AND DISCUSSION

In this section will describe the results that have been obtained in research. Based on analysis results of the study completeness of seventh grade students SMP Negeri 1 Anggeraja for experimentall class that consists of 30 students obtained 29 or 97% students have been complete their study. In this research also conducted assessment of the students attitude in learning process by using teaching materials. Aspects that considered as factors of assessment namely: motivation and interest of students, attention and activeness of students.

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A. The Result of Descritive Analysis

The purposes of result of descriptive analysis is describe the characteristics of research response on treatment. In this case, the analysis will using frequency table, percentage, mean, highest scores, lowest scores, and standard of deviation in each presentation of treatment response characteristics for each treatment as follows:

This table is describe the result of descriptive analysis data of mathematics study result for experimental group (students taught by using teaching materials).

TABLE 1. DESCRIPTION OF RESULT IN MATHEMATICS STUDY OF SEVENTH GRADE STUDENTS OF SMP NEGERI 1 ANGGERAJA FOR EXPERIMENTAL CLASS

STATISTICS	STATISTICS SCORE
Sample size	30
Ideal maximum score	100
Mean score	83,60
Median	84,50
Modus	77
Standard of deviation	9,912
Variance	98,248
The score range	35
Minimum score	65
Maximum score	100

The result of mathematics study for experimental class namely mean score is 83,60, median is 84,50, modus is 77 and standard of deviation is 9,912. Meanwhile, the score range is 35, highest score is 100 and lowest score is 65.

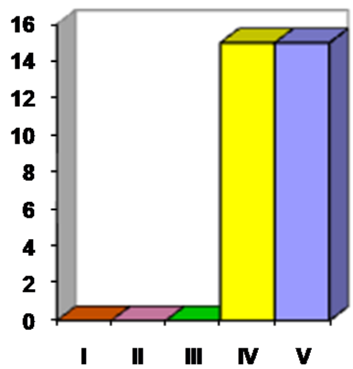
Based on category from Depdikbud, so the result of mathematics study in the experimental class (the class taught by using teaching materials) frequency and score percentage will be cathegorized as follows:

TABLE 2. DISTRIBUTION OF FREQUENCY AND PERCENTAGE FROM THE RESULT OF MATHEMATICS STUDY SEVENTH GRADE STUDENTS OF SMP NEGERI 1 ANGGERAJA FOR EXPERIMENTAL CLASS

Score (%)	**Category**	**Frequency**	**Persentage (%)**
0 – 34	Very Low	-	-
35 – 54	Low	-	-
55 – 64	Fair	-	-
65 – 84	High	15	50
85 – 100	Very High	15	50
Total		30	100

For more detail, data in the table can be seen in diagram 1 as follows.

DIAGRAM 1. FREQUENCY OF LEARNING OUTCOMES FOR CLASS EXPERIMENT



Explanation:

I = very low, II = low, III= fair, IV =high, V = very high

Having regard to the frequency distribution table 2. as well as the diagram 1 can be obtained information that results for students taught using teaching materials of 30 students of class VII SMP Negeri 1 Anggeraja selected as the study sample of 15 respondents, or 50% of learning outcomes are in the high category and 15 respondents or 50% of learning outcomes are in very high category, while the average score was 83.60 learning outcomes of the ideal score of 100 with a standard deviation of 9.912 so it can be concluded that the learning outcomes of students of class VII SMP Negeri 1 Anggeraja taught using instructional materials classified as "high".

The following table illustrates the results of descriptive analysis data result of learning mathematics for control class.

TABLE 3. DESCRIPTION OF LEARNING OUTCOMES MATHEMATICS SEVENTH GRADE STUDENTS OF SMP NEGERI 1 ANGGERAJA FOR CLASS CONTROL

STATISTIC	STATISTIC VALUE
Thesample size	30
Ideal maximal score	100
The average score	64,07
Median	65
Modus	68
Deviation standart	9,996
Variance	99,926
The range of scores	40
The minimum value	44
The maksimum value	84

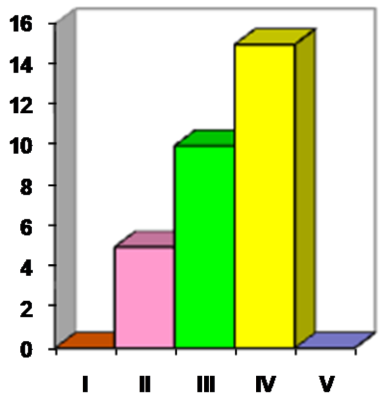
Results mathematics for control class is obtained an average score of 64.07, median is 65, modus is 68 and a standard deviation of 9.996. The range of scores 40 where the 84 as the highest score and the lowest score 44.

TABLE 4. FREQUENCY DISTRIBUTION AND PERCENTAGE OF LEARNING MATHEMATICS OUTCOMES SEVENTH GRADE STUDENTS OF SMP NEGERI 1 ANGGERAJA FOR CLASS CONTROL

Score **(%)**	Category	Frequency	Percentage **(%)**
0 – 34	Very Low	-	-
35 – 54	Low	5	16,67
55 – 64	moderate	10	33,33
65 – 84	high	15	50
85 – 100	Very high	-	-
Total		30	100

For more details, the data in the table can be seen in chart 2 below.

DIAGRAM 2. FREQUENCY OF OUTCOMES LEARNING FOR CONTROL CLASS



Explanation:

I = very low, II = low, III = fair, IV = high, V = very high

Having regard to the frequency distribution table 4. with diagram 2. can be obtained information that results for students who are taught without the use of teaching materials of 30 students of class VII SMP Negeri 1 Anggeraja selected as research sample that is 5 respondents or 16.67% of learning outcomes are in the low category, 10 respondents or 33, 33% of learning outcomes in the fair category and 15 respondents or 50% were in the high category, while the average score was 64.07 learning outcomes of the ideal score of 100 with a standard deviation of 9.996 so it can be concluded that the learning outcomes of students of class VII SMP Negeri 1 Anggeraja who taught with not use teaching materials classified as " fair ".

B. The Results of Inferential Statistical Analysis

Inferential statistical analysis was used to test research hypotheses; the analysis used the t-test. Before, the t-test tested for normality and homogeneity of variance in each class first. Normality test aimed to see if the data on learning outcomes of mathematics does not deviate from the normal distribution. The homogeneity test is to see whether the two groups come from a homogeneous population.

1) Normality test. Data normality test in learning of mathematics result class VII SMP Negeri 1 Anggeraja was using the following criteria.

a) The significance value or probability value <0.05, distribution is not normal
b) The significance value or probability value> 0.05, distribution is Normal

TABLE 5. TEST OF NORMALITY

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Kelas	Statistic	df	Sig.	Statistic	df	Sig.
Hasil Belajar Matematika	Eksperimen	,114	30	,200*	,955	30	,223
	Kontrol	,115	30	,200*	,974	30	,664

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the analysis of data normality test Table 5, the obtained value of p = 0.200, which means 0.200>0.05, it indicates that the data result of learning mathematics scores for these two groups of the population is normally distributed.

2) Homogeneity test. Test of homogeneity of the population variance use testing of Levene Test, this test is intended to know whether or not a homogeneous population variance.

a) The significance value or the probability value <0.05 the data comes from populations which have not equal variances.
b) The significance value or the probability value >0.05 the data comes from populations which have same variances.

TABLE 6. TEST OF HOMOGENEITY OF VARIANCE

		Levene Statistic	df1	df2	Sig.
Hasil Belajar Matematika	Based on Mean	,063	1	58	,803
	Based on Median	,052	1	58	,820
	Based on Median and with adjusted df	,052	1	57,252	,820
	Based on trimmed mean	,062	1	58	,805

Based on the analysis of data result homogeneity test Table 6, it appears that sig value or testing of Levene Test is 0.803. From this result it appears that for sig> 0.05. It can be concluded that the data of mathematics learning result for the two groups come from the same population (homogeneous).

3) Hypothesis test.

After all the requirements of analysis are completed then do a hypothesis testing to the hypothesis test for examine the hypothesis which has been showed above, which reads:
"The achievement of learning mathematics which is taught to student with use an integrated teaching material aspects of local culture *Massenrempulu* more effective than the mathematics achievement of students taught without the use of teaching materials in VII class SMP Negeri 1 Anggeraja".

The statistical tests in this research are:

$$H_0 : \mu_1 \leq \mu_2 \text{ opponent } H_1 : \mu_1 > \mu_2$$

with

μ_1 : The achievement learning average that taught with use teaching material.

μ_2 : The achievement learning average that taught without use teaching material.

T-test test were used was t-test for Equality of Means, with the testing criteria are:

a) If the Calculate Statistic (rate of t out put)> Statistical Table (tables t), H_o is rejected

b) If the Calculate Statistics (rate of t out put)<Statistical Tables (tables t), H_o accepted

TABLE 7. INDEPENDENT SAMPLES TEST

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Hasil Belajar Matematika	Equal variances assumed	,063	,803	7,600	58	,000	19,533	2,570	14,389	24,678
	Equal variances not assumed			7,600	57,996	,000	19,533	2,570	14,389	24,678

Based on the value t = 7.600 and value of t table = 2.00 then the t count> t table, then Ho is rejected. It was concluded that the learning achievement of students taught use teaching materials is better than the students who are taught without use teaching materials. The average student achievement of experimental class higher at 83.60 from the average achievement of the control class is 64.07.

Next will be tested which is better between the use of teaching materials with no use of teaching materials, that testing as follows:

$$\textit{Hipotesis } H_0 : \mu_1 \leq \mu_2 \text{ opponent } H_1 : \mu_1 > \mu_2$$

The calculations result shows that the value of t = 7.600 and the value of t table = 2.00 then the t–count > t-table then H_1 accepted. So, it can be said that the average of the student learning result are taught with use teaching materials integrate with the aspects of local culture *Massenrempulu* better than the average of student learning result that are taught without the use of teaching materials. It shows that "The achievement of learning students taught use teaching materials integrate with the aspects of local culture Massenrempulu better than the achievement of learning student taught use teaching materials in VII class SMP Negeri 1 Anggeraja" proven to be true in significance level of 5%.

C. Discussion of the Research Result

From the analysis result of completeness learning can be seen from 30 students obtained 29 or 96% of students who have been passed in study. From the results of the learning process, it is known that students taught use the teaching material which is integrated with the aspects of local culture *Massenrempulu* more active than students taught without use teaching materials that can be seen from the percentage of student's activeness that is taught use teaching materials always rise. From this results indicate that learning with use the teaching material which is integrated with the aspects of local culture *Massenrempulu* effective to the students of SMP Negeri 1 Anggeraja.

From the results of analysis descriptive can be known that students taught use the teaching material which is integrated with the aspects of local culture *Massenrempulu*, the average score was 83.60 of student learning result are in the high category, while the students taught without the use of teaching materials an average score of student learning result is 64.07 in a category is moderate. From the result shows that the achievement learning of mathematics students of VII class SMP Negeri 1 Anggeraja taught use an teaching material which is integrated with the aspects of local culture *Massenrempulu* includes in the "High" category and taught without the use of teaching materials included in the "Fair" category.

The result of inferential statistical analysis showed that the results of the t = 7.600 and the value of t table = 2.00 be obtained the value of t > t table, then Ho is rejected and H_1 accepted. From that result analysis shows that "student achievement taught using teaching materials is better than the learning achievement of students taught without the use of teaching materials in the triangle material".

Based on the explanation above, it can be obtained information that learning by using the integrated teaching material aspects of local culture *Massenrempulu* more effective than learning without the use of teaching materials. Thus, student achievement taught using teaching materials which is integrated with the aspects of local culture *Massenrempulu* better than the students who are taught without the use of teaching materials. So, it very wise when every educator prepare teaching material contextually, for example which is integrated with the aspects of local culture *Massenrempulu* that for can be the effective and efficient learning, because the teaching materials students can learn independently in school and at home. In addition, indirectly teaching materials that are integrated with aspects of local culture can help students remember their culture characteristic.

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ME – 75

Effectiveness of Cooperative Learning Approach (Snowball Throwing) in Logics Instruction at AMIKOM Mataram

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Abstract—This study aimed to describe effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional) and compare effectiveness of the snowball throwing's type of cooperative learning approach with conventional approaches in logics instruction seen from the aspect of student mathematics achievement in the academic year 2014/2015 at AMIKOM Mataram. The research is a quasi-experiment with nonequivalent comparison-group design. Its population is all of the student of informatics management (MI) with sample used are students of MI A and MI C+Exe. To test the effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional), data were analyzed using one sample t-test. To test that the snowball's throwing type of cooperative learning approach is more effective than conventional approach, the data were analyzed using ANOVA followed by Benferroni's t-test. The results showed that the instruction approaches (the snowball throwing's type of cooperative learning and conventional) is effective and the snowball throwing's type of cooperative learning approach is more effective than conventional approaches in logics instruction seen from the aspect of student mathematics achievement in the academic year 2014/2015 at AMIKOM Mataram.

Keywords: *the snowball throwing's type of cooperative learning approach, student mathematics achievement*

I. INTRODUCTION

Mathematics is the mother of science. The sentence is appropriate to represent the existence of mathematics to other sciences, including computer science. A person will not be clever in computer science when they are not clever in math. That is, if students of AMIKOM Mataram want to be clever or to obtain good result in the computer class, then they must have solid and good foundation.

Logic of math is one of the object of studied in mathematics. Logic of math is the basic in mathematics. Therefore, studying logic of math is compulsory for all students in AMIKOM Mataram. However, studying logic of math well, is not easy, but experienced some problems in instruction. One example of the problem is the low of student mathematics achievement in logic of math. After analyzed, one cause of the problem is an instruction approach that lecturer apply is less precise. Lecturer tend to apply a lecturer oriented learning approach (conventional approach). Therefore, implement, a student oriented learning approach is the right solution to solve the problem about the low of student mathematics achievement. One of the example of a student oriented learning approach is the snowball throwing's type of cooperative learning approach.

Furthermore, academic achievement is defined as the results obtained by the students during the learning activities take place. The results are poured in the form of a numerical rating [1]. In addition, academic achievement is also interpreted as a person's competencies that acquired after learning activities. Competence is then related to the domain of knowledge [2]. In line with this, academic achievement is also interpreted as the results obtained after the student learning process. Usually, the results are set forth in the form of numbers or values that represent them in the learning ability [3]. Based on the explanation above, in this study, student mathematics achievement is the result that be obtained after the student learning activities take place and expressed in the value form.

Simply put, cooperative learning approach is defined as an instruction approach that focuses on learning activities in small group in order that the students be able to learn and work together, giving rise to an optimal learning experience. However, not all group instruction belong to the group of cooperative learning, but must have five criteria, that is: positive interdependence, face-to-face interaction, individual responsibility, social skills, and evaluation of the group process [4].

In addition, also disclosed that the cooperative learning approach divide students into small groups with a number of membership about 4-5 people who heterogeneous [5]. Heterogeneous in the sense, heterogeneous in academic ability and gender. Furthermore, another opinion reveals that the cooperative learning approach should be based on "creation, analysis, and systematic application of structures, or content-free ways of organizing social interaction in the classroom [6]."

Cooperative learning approach consists of various types, among others: jigsaw, student-teams-achievement-divisions (STAD), think-pair-share (TPS), group-investigation (GI), and snowball throwing. In this study, the type used is the snowball throwing's type. The steps are as follows: (a) lecturers divide students in small groups (4-5 people) are heterogeneous with one member of the group as the group leader; (b) lecturers calling every group leader to get together and then given an explanation of the subject matter (the members of the group read the subject matter); (c) lecturers ask the group leader to return to their groups and then give explanations and discussion with the others member of the group about the subject matter; (d) lecturers ask each students group to create a question relating to the material on a piece of paper and then rolled into a snowball shape; (e) lecturers ask to throw a snowball that has been made to the others of student group; (F) lecturers ask each students group to answer the questions that they receive; (g) lecturers ask some groups to present and discuss the subject matter and some questions received in front of the class; and (h) together with the others student, lecturers evaluate answers and learning activities that have been performed [7].

Based on the explanation above, the purpose of this study is to describe effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional) and compare effectiveness of the snowball throwing's type of cooperative learning approach with conventional approache in logics instruction seen from the aspect of student mathematics achievement in the academic year 2014/2015 at AMIKOM Mataram. In addition, the presence of this study are expected to provide a contribution to learning in AMIKOM Mataram, particularly with regard to the snowball throwing's type of cooperative learning approach. As reinforcement in this study, with regard to the effectiveness of the snowball throwing's type of cooperative learning approach seen from the aspect of student learning achievement is supported by Agustina research conducted in 2013 which revealed that the approach is effective in terms of aspects of student learning achievement [8].

II. RESEARCH METHOD

The kind of this research is a quasi-experiment that designed use nonequivalent comparison-group design. This research was conducted at AMIKOM Mataram from October 2014 to January 2015. The population is all students of Management Information (MI) in the academic year 2014/2015, while the sample is a student of MI A and MI C+Exe (random sampling). In this study, the independent variable is the instruction approach (the snowball throwing's type of cooperative learning and conventional) and the dependent variable is student mathematics achievement. The instruments that used to measure student mathematics achievement is mathematics achievement test.

In this study, data collection techniques done by starting giving tests before treatment to graders MI A and MI C+Exe, continued with give the treatment (application of the snowball throwing's type of cooperative learning approach as experimental group and conventional approaches as control group), and ends with the provision of tests after treatment of the students in both classes. The technique of data analysis done by describing the data and inferential statistical analyzes of data obtained. Description of data is done by finding average, standard of deviation, variance, minimum score, and maximum score, both for the data before and after treatment.

One sample t-test was used to test whether the instruction approaches (the snowball throwing's type of cooperative learning and conventional approach) is effective in logic instruction seen from the aspect of student mathematics achievement. Its criteria: H_0 (instruction approach is not effective seen from the aspect of student mathematics achievement) was rejected when the significance of t is less than 0,05. Furthermore, *ANOVA* test was used to test whether there are differences of beginning knowledge between two classes sample in logics instruction seen from the aspect of student mathematics achievement. Its criteria: H_{01} (there are not differences of beginning knowledge between two classes sample) was rejected when the significance of F is less than 0,05. The same test using ANOVA was performed to test data after treatment. It is intended to see whether there are differences of effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional approach) in logics instruction seen from the aspect of student mathematics achievement. Furthermore, *Benferroni's t-test* was used to see whether the snowball throwing's type of cooperative learning approach is more effective than conventional approaches seen from the aspect of student mathematics achievement. Its criteria: H_{02} (the snowball throwing's type of cooperative learning approach less effective than conventional approaches) was rejected when the significance of t is less than 0,05.

III. RESULT AND DISCUSSION

In this study, the implementation of instruction approaches (the snowball throwing's type of cooperative learning and conventional approach) has been going as well as the instruction implementation plan. However, there are some things that must be get attention in the implementation of the snowball throwing's type of cooperative learning approach, as students asked more serious during the process of snowball throwing and ask the leader of group to learn more about the subject matter than his/her members.

Data description of student mathematics achievement for both snowball throwing class (STC) and conventional class (CC) can be seen in Tab. 1. According of Tab. 1 obtained information that the average value both before treatment is below 75 and after treatment is above 75. In addition, also obtained information that there are students who earn a perfect score (100) in class of snowball throwing. To test normality and homogeneity of data, for both STC and CC (before and after treatment) can be seen in both Tab. 2 and Tab. 3. Tab. 2 below show that the data of student mathematics achievement is normal (the significance value is more than 0,05). From Tab. 3 obtained information that the data of student mathematics achievement meets the homogeneity test because the significance value is more than 0,05.

TABLE 1. DATA DESCRIPTION OF STUDENT MATHEMATICS ACHIEVEMENT

Description	**STC**		**CC**	
	Before	***After***	***Before***	***After***
Average	32,44	91,79	34,72	81,67
Theoretical Maximum Value	100	100	100	100
Theoretical Minimum Value	0	0	0	0
Maximum Value	85	100	50	95
Minimum value	5	70	15	70
Standard of Deviation	16,29	8,62	12,87	8,7
Variance	265,62	74,32	165,66	75,71

TABLE 2. THE RESULTS OF NORMALITIY TEST

Class	**Sig.**	
	Before Treatment	***After Treatment***
Snowball Throwing	0,184	0,056
Conventional	0,07	0,487

TABLE 3. THE RESULTS OF HOMOGENEITY TEST

	Before Treatment	**After Treatment**
Sig.	0,311	0,915

TABLE 4. THE RESULTS OF ONE SAMPLE T-TEST

Aspect	**Sig.**	
	STC	***CC***
Student Mathematics Achievement	0,000	0,000

TABLE 5. THE RESULTS OF ANOVA

Treatment	**Sig.**
Before	0,505
After	0,000

TABLE 6. THE RESULT OF BENFERRONY T-TEST

Aspect	**Sig.**
Students Mathematics Achievement	0,000

Furthermore, the effectiveness of instruction approaches (the snowball throwing's type of cooperative learning and conventional approach) can be seen in Tab. 4. Table 4 shows that the implementation of the snowball throwing's type of cooperative learning approach is effective seen from student mathematics achievement. Besides that, the implementation of conventional approach is effective too. Those are because the significance value of t less than 0,05.

Test about the differences of the beginning knowledge and the effectiveness of two classes sample can be seen in Tab. 5. This table show that there are no difference of the beginning knowledge between STC and CC (the significance value is more than 0,05) and there are differences in effectiveness between STC and CC because the significance value is less than 0.05. Therefore, *Benferroni's t-test* was used to seen the differences of effectiveness between the two instruction approaches. The results of *Benferroni's t-test* can be seen in Tab. 6. Based on Tab. 6, there was information that the snowball throwing's type of cooperative learning approach is more effective than conventional approach because the significance value is less than 0,05.

The results of the above study then in line with the study of relevant theory and research which reveals that the snowball throwing's type of cooperative learning approach is effective seen from the aspect of student mathematics achievement. This is because, in instruction by using the snowball throwing type of cooperative learning approach, students are given more opportunities to interact with other students. In addition, the implementation of this approach, students felt more understand about the subject matter. This is because when students are having difficulty in learning, they tend to not be shy to ask to the leader of their respective groups. Furthermore, the snowball throwing's process is the most favorable instruction process. Although, impressed by the messing around, this process makes it look more students enjoy learning and do not feel pressured in class. The process to create questions and then answer himself was another reason why the type snowball throwing's type of cooperative learning approach is effective and more effective than conventional approach. With them create questions, they will automatically learn how to answer that question and how to correct the working of other groups.

In addition, the discussion was not only done within the scope of the group, but the scope is larger, that is class. This was apparent when the lessons that all seven do. Group of students who have problems will tend to respond in case questions were answered by another group of students who are less precise. In addition, another group of students who had come to give a response at the time of implementation of these activities. One thing that became added value in the implementation of the snowball throwing's type of cooperative learning approach is this instruction approach at least there will be some students who will be an expert student in the class, that is the leader of the group. It is seen from the results of the analysis of student mathematics achievement test that the scores of the leader of the group tend to be higher than the group members.

IV. Conclusions and Recommendations

The instruction approaches (the snowball throwing's type of cooperative learning and conventional) is effective and the snowball throwing's type of cooperative learning is more effective than conventional approaches seen from the aspect of student mathematics achievement in the academic year 2014/2015 at AMIKOM Mataram. Some things that are suggestions and needs to be follow-up of this study are: (a) although both instruction approaches (the snowball throwing's type of cooperative learning and conventional) is effective but lecturer should ask students to more serious and more encourage in order to get better output or result of the instruction, (b) a snowball throwing form can be modified to the others form, such as aircraft and plane, and (c) conduct more analysis about student's enthusiasm towards instruction approach is preferred.

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"ELIP – MARC" Activities Via TPS of Cooperative Learning to Improve Student's Mathematical Reasoning

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Abstract. Mathematical reasoning is the basis of learning mathematics, as a glue of the five strand to improve learners' proficiency of mathematics. This study is the development of learning interaction that aims to improve students' mathematical reasoning. This learning interaction through "ELIP-MARC" activities, which is an acronym of Eliciting, Inserting, Pressing, Maintaining, Reflecting and Confirmating as steps of the learning process to improve Mathematical reasoning. This activity is implemented in Think – Pair- Share (TPS) cooperative learning, which is a type of cooperative learning model that is simple, friendly and familiar. This study is quite important to do, because the student's reasoning tend to be very low in our country and the other developing countries also. However, student's mathematical reasoning can actually be developed as long as teachers are willing to be patient and persistent on the learning process with right steps, and be supported by precise and challenging tasks . The chronologies of the development of these models follow the (Ploomp: 2007) developed, consisting of (1) Preliminary research, (2) Prototyping stage, (3) Summative evaluation, (4) Systematic reflection and documentation. Outcomes of this study is a model of interaction that consists of Structure (syntax) learning, (2) Social Systems, (3) Principles of reaction, (4) Support System, (4) direct or instructional effect and nurturant effects.

Keywords *: Activities, "Elip-Marc" , Learning, Mathematical , Reasoning*

I. INTRODUCTION

The purpose of this research is to develop an interaction model of learning through "Elip- Marc" activities via TPS cooperative learning to improve students ' mathematical reasoning "*ELIP-MARC*" as an acronym of Eliciting, Inserting, Pressing, Maintening, Reflecting and Confirmating, have been adapted from Brodie's serearch follow up. The "*ELIP-MARC*" Activity is implemented in *TPS* cooperative learning, one of the cooperative learning model that is simple, friendly and familiar. This research is very important to do, because the student's reasoning in our country and the other developing countries also tend to be very low, such as research results [15] at Nebraska; [1] at Kuwait; [49] at Taiwan; [43] at Swedia. Also in Indonesia, particularly in Malang city where researchers are domiciled. However, student's mathematical reasoning can actually be developed as long as teachers are willing to be patient and persistent on the learning process with right steps, and be supported by precise and challenging tasks [17].

The learning process is a dynamic situation because learning is a social process, which is influenced by environmental factors, public demand for the competence of graduates, changes in government policy on graduation standards, a paradigm shift learning and education technology influence. [35]. Therefore, it is appropriate that Ref. [24] suggested to us as teachers are always dynamic conduct research and develop model of learning to improve students' proficiency.

Learning model development research is always evolving over time. Some education experts are researching and developing learning models, among others: Rechey and Nelson, Greeno, Collin and Resnik (in [44]); Hilda Taba, Jerome Bruner, Emily Calhoun, Joseph Schwab, Richard Suchman, Michael Pressley, Richard Anderson, Wiliam Gordon and David Ausebel (the education experts who developed the model - based learning process information); Benyamin Bloom, Tom Good, Albert Bandura, B.F. Skiner (the education experts who developed the model - based learning model of social) (in [24]); Roger and david Johson, Robert Slavin, Johnson and Johnson, Sholomo Sharan (the education experts who developed the model of cooperative learning).

The learning model is familiar and is often used by the teacher is cooperative learning models, among others: Jigsaw, Make a Macth, Think – Pair – Share (TPS), Students Team Achevement Development (STAD), Team Game Tournament (TGT), Snowball Throwing, etc [47]. The main characteristic of cooperative learning is to teach teamwork and interaction between students, which has the purpose, among others: the learning results, acceptance of diversity, and the development of social skills. Today, the learning models has been researched and developed by doctoral students of various educational institutions in Indonesia, including in the Malang State University. This model developments are various, that are adapting, adopting, combining of learning models or may be pure result of development by itself. These focus are various, there is on interaction, on the device or may be on all components. The author intends to integrate one familiar learning model used by teachers with the interaction model of the learning process that aims to improve students' mathematical reasoning.

II. THEORITICAL FRAMEWORKS

A. Mathematical Reasoning in Mathematics Learning

Reasoning in mathematics has a very important in a person's thinking process. *Mathematical understanding and thus mathematical knowledge depend upon reasoning* [31]. Otherwhise [3] explain that *contend that ". . .the notion of mathematical understanding is meaningless without a serious emphasis on reasoning"*. Ref. [3] also think that *understanding is founded on reasoning in that students must use reasoning to understand relationships and make connections to new ideas.* ***Through reasoning*** *students can reconstruct prior knowledge, act upon this prior knowledge, and create new understandings. When given the opportunity to reason about mathematical knowledge in a supportive environment, students as young as elementary school can create conjectures, reflect upon and evaluate them, and try to convince others to accept these justifications* [10]. To improve focuses on reasoning, the students need to present their ideas in a classroom and discuss their problems involving all members of the class [29]. Ref. [27] have a view that the success of a comprehensive study of mathematics influenced by five strands are intertwined and interdependent. The fifth strand is *Conceptual Understanding*, *Procedural Fluency*, *Strategic competence*, *Adaptive Reasoning*, and *Productive disposition.* Ref. [27] Also concluded that the mathematical skills can not be achieved by focusing just on one or two strand but build in all five strand, because each strand interact and reinforce each other, but at a certain moment the mathematical reasoning that is called adaptive reasoning as the glue to unite each other of the fifth strand.

Referring to the views [27] on a five-strand affecting one's mathematical proficiency, [7] provides follow-up of research that involves five teachers in Africa, that aspect to consider in learning emphasis on reasoning is divided into five subcategories that is: (1) *Insert*, (2) *Elicit*, (3) *Press*, (4) *Maintain*) and , (5) *Confirm*. Ref. [31] found 8 components to encourage the habit of reasoning (culture of reasoning) in the learning process of mathematics, namely: (1) facilitating the classroom for collaborative learning, (2) Give the task with a design that encourages reasoning, (3) Encourage students to represent mathematical ideas in many ways, (4) provide Media adequate, (5) Invite students to give an explanation and justification of reasoning, (6) Emphasize the decision meaningful, (7) give interventions meaningful by giving the response from the students' answers, the strengthening or reward of student success, (8) Get used to discuss student work (Mathematical discussion).

B. Learning Based Questions and Tasks in *Elip – Marc* Activities

The basic principle of all effective learning is to ask questions in the classroom. In the classroom the teacher asked a question for various reasons [11], among others: (1) examine students' understanding of learning, (2) evaluate the effectiveness of learning, (3) improve the mindset of a high level. Asking questions is one of the basic learning strategies that can be applied to almost all areas of the subject matter and grade levels. If done effectively, these strategies can encourage engagement, improve learning, motivate students, and provide feedback on the progress of learning, both for teachers and students [14]. The characteristics of effective questions is [9] short, clear, focused, relevant, constructive, neutral, and open. The author agrees with [20] that the implementation of the question strategy would effectively increase the interaction of the learning process, and engage students actively.

Key the effective question strategy is to ask questions that allow us to achieve the learning objectives *(Eliciting)* [14]. Teacher's ability to listen and respond student's responses through questions to sharpen his thinking *(Pressing)* allowing them to find their own mistakes [16; 32; 36; 15] *(Inserting)* . Ref. [36]

found that when students were asked to answer and follow up questions (*Pressing*), encouraging them to think more deeply about their response, the accuracy increased significantly. Question higher level focused on the essential elements to create a conducive environment for students to think critically about mathematical concepts [21; 16]. While directing or guiding questions (Prompting Questions), questions asked to give direction to the students in his thinking process (*Inserting*). This is usually done when there is a certain part in the discussions that are considered important, or in a way that is done by providing additional questions to answer the main question. Questions digging (Probing Question), questions that will encourage students to learn more about its own answer (*Maintening*), students are encouraged to increase the quantity and quality of previous answers. Most teachers according to [30] to ask questions to the five main objectives: (a) to engage students in learning; (b) to encourage students' thinking and understanding; (c) to assess student progress; (d) to control the students; and (e) to review the contents of important lessons (*Confirmating*).

C. Reflecting In Learning Process

Facilitating the development of students' skills of reflection is an important task for mathematic teachers, for reflection at the end of each learning activity is considered to be central to increasing the learning of mathematics [2]. Reflecting at each end of the learning process students will be aware of and actively control their learning, assess what they know, what they need to know, and what will happen if they do not know it. Ref. [41] said that the reflection does bridge the gap in learning situations. Ref. [6; 40] concluded that the reflection is an important part of the process to analyze and articulate the problem and make connections with what they do in the classroom.

For teachers, reflecting is the practice in which teachers have to learn from their own teaching practice and gradually increased over time. Teachers who practice reflective thinking using inquiry as a tool to engage critically with the key questions and issues in their teaching practices [23]. To reflect as a systematic means to achieve a broader understanding of the situation of teaching and improve the quality of learning [26]. While [42] suggest that in order to answer the question in resolving the problems faced by students one way is motivate them to reflect on what they have done in the learning process and looked back matter what comes up, analyze it and make decisions specifically. However, as evidenced by a study [8; 40; 5; 46], students may not be able to think critically because their teachers are not able to integrate critical thinking enough in their daily practice that requires some reflection. The three main phases in the cooperative learning TPS is Think - Pair - Share. Elip activities - Marc majority occur in Share phase, can be viewed at Tabek 3.1

D. Elip - Marc Activities in TPS Cooperative Learning

Cooperative learning is a term for a set of teaching strategies that are designed to teach teamwork and interaction between students. At least there are three main goals of cooperative learning, which is the result of academic learning, acceptance of diversity, and the development of social skills. *Elip - Marc* Activities in the *TPS* cooperative learning process oriented [14] to teach teamwork and interaction between students based on learning theory Vygotsky that emphasizes social interaction as a mechanism to support cognitive development [14] with learning activities adapting lessons step that emphasize mathematical reasoning [7]. In each of these learning activities give students opportunities to collaborate in pairs to solve existing problems in the student’s worksheet that has been provided. the student’s worksheet format adopts the term RAT (*Reasonable Answer Test)* of [1] and modify the steps Reasonable Evaluating Test [12].

F. Problems Solving and scaffolding steps as a base Form of Tasks on Elip – Marc activity

Realistic Mathematics Education provides students opportunity to discover and construct mathematical concepts based on a realistic problem given by the teacher. The problem of Realistic situation allows students to use informal ways to solve it. Student’s informal ways an important role to rediscovery and constructing concepts. This means that the information given to students has been linked with a scheme (network representation) of them. Through classroom interaction student’s scheme will be stronger. Such as advice [34] that problems solving related to daily life should be the main focus of learning mathematics. Model interaction through Elip – Marc activities based of them. Examples issues of contextual problems presented in early learning for generating the Elip - Marc activity about the volume of the prism is *"A swimming pool visible surface is rectangular with a size of 30 m x 10 m. The pool sloped, the water depth at the shallow end of 3 m continues to ramp up at the end of 5 m. (a) Tos sketch the shape of the swimming pool! (b) What form of whether the swimming pool and (c) Determine the volume of water that can be accommodated in the pool! "*

The problems that appear in each learning activity is contextual problems that allow students to solve them with: (1) create a sketch, (2) determine the preferred strategy, (3) translating problems into mathematical models and using strategy selection to solve problems, (4) check the work, (5) Make the conclusion of the work and give the reasonable answers. Students are expected to provide an explanation or description of the measures chosen [48]. Their steps or the appropriate action to make learning mathematics or the process of completing a mathematic problem in class. The action that is interpreted as a scaffolding practices in helping the learning process in the classroom [25].

III. RESEARCH APPROACH AND DEVELOPMENT RESULTS

A. Research Approach

This study is in the research development of education (educational design research). Ref. [4; 44], defines the design of educational research as "a range of approaches, with a view to generate new theories, artifacts, and practical models that explain and potentially have an impact on learning with a natural setting (naturalistic)". Ref. [37], defines educational design research as "a systematic review of designing, developing and evaluating educational interventions (such as programs, strategies and learning materials, products and systems) solutions to solve complex problems in educational practice, which also aims to promote our knowledge of the characteristics of the interventions as well as the design and development process. Based on the above definition the essence of education development research is a systematic process consists of designing, developing and evaluating an educational intervention that aims to solve complex problems in educational practice ,

Development approach in this study [13; 44], has the following characteristics: (1) interventionist: research aims to design an intervention in the real world; (2) Iterative: cyclical approach combines research (recycling), which includes the design, evaluation and revision; (3) Process oriented: black box model on the measurement of input-output is negligible, but it is focused on understanding and developing models of intervention; (4) Utility oriented: the advantages of the draft is measured to be put to practical use by the user; and (5) Theory oriented: the design is built based on a theoretical proposition then do field testing to contribute to the theory.

B. Development Model

Model of development this research is the development study, because of the nature of this research is to develop design principles for practical purposes in the field as the primary purpose [33]. The study was based on problems in the field and in the implementation of participants, researchers, experts and other stakeholders with the research stages to follow [33; 38] with the steps: (1) Preliminary research: analysis of the context and issues for the development of a conceptual framework grounding through literature reviews, field observations and preliminary research or conduct; (2) Prototyping stage: designing user design, prototype through recycling optimize the design, formative evaluation and revision. The resulting product specifications as outlined in section (C) below; (3) summative evaluation: an evaluation of the effectiveness of the implementation and use of the prototype. The evaluation was conducted for the eighth grade students of 3th Kepanjen Junior High School at the end of the semester with the matter " Problems solving of volume and wide areas of three dimension geometry”. Evaluation of the prototype performed a total of 12 meetings. Half of meeting the authors as a model teacher observed by two colleagues and an expert mathematic education, while the other half of the meeting as a teacher model is a colleague of the author as an observer accompanied by two colleagues and an expert mathematic education; (4) Systematic reflection and documentation: describe the overall study to support the analysis, and then specifying design principles and articulate its.

C. The Outcome Research

The products specification in this study is developed a model of interaction through Elip – Marc activities via *TPS* cooperative learning who have practical, valid and effective criteria to improving students' mathematical reasoning abilities. So there are three types of product prototypes are developed, namely: (1) learning model, as a conceptual framework and a reference in developing the supporting device. Components of this model consists of a syntax model, the social system, the principle of reaction, instructional and nurturant impact; (2) learning device, for carrying out teaching methods and to measure the practicality and effectiveness of the learning model, and (3) The research instrument to assess the quality of the model and the device, with regard to the validity, practicality, and effectiveness. Development of a prototype of the three types of products by following the cyclical steps [33; 38]. Each type of prototype emphasize the Elip – Marc activity of *TPS* cooperative learning oriented.

Table 3.1.
ELIP - MARC Activities of *TPS* Cooperative Learning Oriented

Fase	The learning activities	Discriptions
THINK	• The teacher show the "word problem" or the "pictorial problem" to start the lesson as a first materials to observe our class , and distributed the "worksheet" to each student • The teacher provide opportunities for every student to: ➢ Observe the problems in "worksheet" ➢ Write keywords contained on the problem ➢ Try to resolve the issue, how they have ways as themselves	• Word problem abaut something that close to the lives of learners or we call it Realistic Mathematic .
PAIR	• The teacher Provide opportunities for students to pair up with a classmate and have them to discuss, exchange ideas related how to solved the problems as they think	
SHARE	• The teacher appoint a student as delegate of pair at random to represent their uotcomes. • By contributing the students' answers The teacher built interaction in our class. • The teacher use guiding questions (Prompting Questions) and Questions digging (Probing Question), to motivated the class do *Elip - Marc* aktivities to: (1)sketching a figures, (2) Determining the preferred	• ***Eliciting*** **:** How to motivate learners to come up with new ideas related to the subject matter covered • ***Inserting:*** How to add an idea, information, facts or other knowledge that is pushing to increase the reasoning learners through questions, answers a response back on learners, making links with previous knowledge and so on. • ***Pressing*** **:** How to motivate learners to emphasize, clarify, justify or explain more clearly the idea that appeared, by asking the question of "How ...", "why ..., And have the

	strategy, (3) Translating problems into mathematical models and using strategy selection to solve the problems, (4) Checking the work, (5) Making the conclusion of the work and give the reasonable answers	student to mention another example, and so on. • ***Maintaining*** : How to motivate and encourage learners to assert on the ideas that come, by repeating it, or ask other students to explain in any other way according to themselves • ***Confirmating* : How t**o confirm the idea is right, give evidence, provide conclusions and affirmation.

Table 3.2.
Form students "worksheet"

<table>
<tr><td colspan="2">Task 01.

A prism water container has rhombus shape of roof. The roof perimeter has measure of 80 dm and one diagonal length of the roof or base is 24 dm. If area of the water prism casing 1.200 dm², determine volume of water that can be accommodated in the venue!</td></tr>
<tr><td colspan="2">Keywords in the above problems are!</td></tr>
<tr><td>Sketching a picture of the situation / problem above is!</td><td>Write explanation part of the picture!</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Solving strategies: (Write down somethings that you might use: a formula related, workflow or anything else you think what help you to resolving the problem)</td></tr>
<tr><td>Write the mathematical model of the situation / problem above and steps to resolve:</td><td>Write an explanation of the mathematical model and the completion steps are!</td></tr>
<tr><td colspan="2">check the work, please!</td></tr>
<tr><td colspan="2">Write down the conclusion:</td></tr>
</table>

Table 3.3
Form Student Reflection

LEARNING PROCESS OF REFLECTION SHEET
1. Writing down important things about the material they have learned
2. Describing briefly and clearly benefit from learning " Sides prism areas" which has been done with the steps that have been passed in both the short term and the long term
3. Describing briefly and clearly if not mastered the material e Sides Prism Areas newly learned.

D. ***Implementation of Elip - Marc Activities in TPS cooperative learning***

In the folowing, we presented snippets example of the transcription of learning process in the classroom involving Elip – Marc activity.

Through the slide showed "word problems" as a first observation of learning materials

> A swimming pool visible surface is rectangular with a size of 30 m x 10 m. The pool sloped, the water depth at the shallow end of 3 m continues to ramp up at the end of 5 m.
> a. Sketching the shape of the swimming pool!
> b.What Shaped whether the swimming pool?
> c. Determine the volume of water that can be accommodated in the pool!

Teacher: *Okay. Now, please consider the problems that exist on the slide, and each person to try sketching the picture. You should colaborete cooperate with less seatmate.*
Student : (The students Trying to translate this into a representation of the sketch figure)
Teacher: Walk around checking student work. The teachers provide scaffolding personally. (Having considered there are several pairs of students who have sketched the picture correctly, the teacher pointed to one couple pouring sketch drawings on the whiteboard)
Students (Bayu) : (sketched picture on the whiteboard)

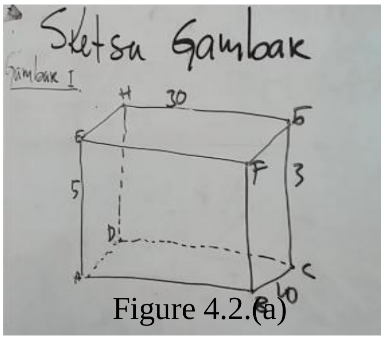

Figure 4.2.(a)

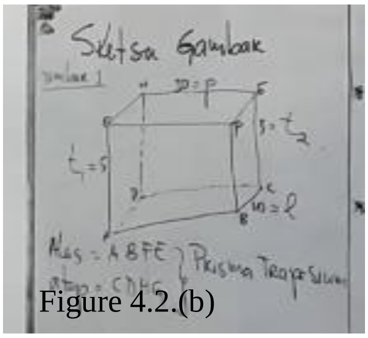

Figure 4.2.(b)

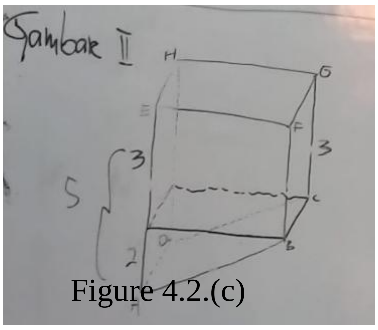

Figure 4.2.(c)

Teacher : *Shaped whether the pool is drawn Bayu (eliciting) .... Saso?*
Saso : *Prism*
Teacher : *Please, Mention the name of the base .... Saso*
Saso (Saso pause) ... with doubt he answered *ABCD.*
Teacher : *Is it true that the base of the prism ABCD, Try to remember again what the main characteristics geometry prism shaped? (Inserting) .... Fanju.*
Fanju : *The geometry shaped the base and the roof has the same shape.*
Teacher : *Ok. Fanju is true. Well now look at the pictuce , what ABCD and EFGH is congruent .... Back to Saso.*
Saso : *No*
Teacher : *Why .... Try to explain! (Pressing)*
Saso : *Due to the size of the AE is not equal to BF.*
Teacher : *Try to note the information on the slide and note the size of the picture belongs to Bayu, which the shape is congruent? (Inserting)*
Bayu : *ABFE and CDHG*

Teacher : *Shaped whether ABFE ……?*
Some students: *Trapezoid*
Teacher : *Yes ... .. then try drawing to be addressed ... .. Bayu*
Bayu (Bayu fix the picture so that it looks like Figure 4.2. (b)
Teacher : *Well, we have got trapezoidal prism whose base*
……………………………………………………………………………………………….
Teacher : *In addition to using the formula Volume of prism = the base area times the high mesurement , can you calculate the volume of the pool with an other ways?* *(Maintaining)*
Aurel : *Yes ... .. Mom, by making Blocking.*
Teacher : *Try to make the picture*
Saso (Saso drawing as shown in Figure 4.2. (c)

IV. CONCLUSIONS AND DISCUSSION

The purpose of this study was to develop a model of interaction through Elip - Marc activities and *TPS* cooperative learning oriented to improve students' mathematical reasoning. The emphasis at this event how Elip - Marc activity in the learning process. It turned out that the results of this study support the previous research such that: If (1) the teacher is pleased to be patient and persistent engage students in the learning process through Elip Marc activities [7], (2) is supported by the task of "word problems" challenging [34], (3) is motivated by the question that digging (Prompting Questions) and guided (Probing Question), [14; 30], (4) and provide students the necessary scaffolding [25]. (5) provide space whorksheet adequate workplace [12], (5) following the RAT steps [1] students were motivated to improve mathematical reasoning. Mathematical reasoning is measured by how students respond Elip - Marc activity in worksheet outlined with RAT format by steps (a) sketching picture, (b) determining a preferred strategy, (c) translating problems into mathematical models and using options sterategy for resolving the problem, (d) checking the work, (e) Making conclusion of the work to provide a reasonable answer [48]. The material in this study is " Three dimension geometry problem solving ". However, the authors suggest that the results of this study can be adapted to the other materials in mathematics learning. However, some of the obstacles we find in the classroom, among others: (1) almost all the students tend to be difficult and does not provide an explanation of a given idea, (2) Most of them tend to not re-check the answers, (3). Should be given a list of questions from each activity Elip - Marc to help teachers motivate students.

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ImprovingStudents' Mathematical Literacy Skills Through Mathematical Process Skills Approach

Quasi-Experimental Study on MTs Student

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Abstract *- This study was conducted in response to the fact that students arelack of mathematical literacy particularly on their ability to use their mathematical knowledge in everyday life. To address the problem, this researchwas conducted using mathematical process skills approach. The purpose of this study are: (1) to compare the achievement attained by the students who are taught using mathematical process approach to the students who are taught using conventional learning in terms of the whole student;(2) to compare the improvement on the literacy skills of mathematical achieved by the students whoare taughtusing mathematical process approach to the students who are taught using conventional learning in terms of the whole student;and (3) to assess whether there is any difference on the improvement of mathematical literacy skills of the students who are taughtusing mathematical process skills approach in terms of the initially mathematical ability (high, medium, and low), and to assess whether there is interaction between the learning (mathematical process skills approach and conventional) and the initial mathematical ability (high, medium, and low) toward the improvement on mathematical literacy. The design of this study is non-equivalent control groupby whichthe samples obtainedare eighth grade students in one of the MTs in KecamatanLakbok, Kabupaten of Ciamis which were selected purposively. The research instruments include mathematical literacy test and attitude scale questionnaire. Based on the analysis,it was found that: (1) the improvement on mathematical literacy ofstudents who were taught using learning process skills approach is better than those who received conventional learning; (2) the achievement onmathematical literacy of studentswho were taught using learning process skills approach is better than those who received conventional learning; (3) the improvement on mathematical literacy of students who were taught using learning process skills approach is better than those who received conventional learningbased oninitialmathematical knowledge (high, medium and low);and (4) Learning using process skills approach significantly contributed to theimprovement of students' mathematical literacy as compared to conventional learning.*

Keyword: Mathematical literacy, Mathematical process skills approach

BACKGROUND

Mathematics is one of the disciplines which taught at every level of education, mathematics is expected to contribute in improving the students' ability, because mathematics is a means of scientific thinking that plays an important role in efforts to develop science and technology in human welfare.

The purpose of learning mathematics at SMP / MTs in Indonesia contained in Standar Isi, if we look closely it appears that the curriculum developed now already noticed the aspects of mathematical literacy development. Mathematical literacy is the ability to formulate, implement and interpret mathematics in various contexts, including the ability to perform reasoning mathematically and using the concepts, procedures and facts to describe, explain or predict events.

A broader sense of mathematical literacy by Kusuma (2010) is that the mathematical literacy contains the ability to construct a set of questions, formulate, solve and interpret problems that are based on the existing context. To be a person who has mathematical literacy, students need to have the whole of this competence although they might be in different degrees.

According to Niss (in Kusumah: 2010), mathematical literacy includes 5 basic capabilities, namely: (1) reasoning and thinking mathematically, (2) mathematical argument, (3) mathematical communication, (4) modeling, (5) the submission and troubleshooting , (6) the representation, (7) symbol, and (8) media and technology.

The importance of this mathematical literacy has not gotten along with Indonesian's students achievement in the eyes of the International. Mastering the mathematical literacy is not fully achieved. This is shown by the results of the Program for International Student Assessment (PISA), which measures the ability of 15 year old students in reading literacy, mathematics, and science. In 2009 even Indonesia ranks 61 out of 65 participants. Mathematical literacy in PISA focuses on students' ability to analyze, reasoning, and delivering ideas effectively, formulate, solve and interpret mathematical problems in a variety of forms and situations.

Although generally the mathematical literacy is low, the level of students' academic ability in the class were various. It determines how the teacher's teaching methods influence on students' abilities. Supposed high-ability students will be able to improve their learning results by using any teaching methods, but the opposite occurred in the low-ability students. Thus, this study will show how the basic students' mathematical knowledge influences the learning method that will be given to the mathematical literacy.

Implanting mathematical literacy in students in learning process should be supported by a good learning atmosphere. A teacher should be able to create a learning environment that allows students to actively learn how to construct, discover and develop their knowledge. Teaching mathematics is not only collating sequence information, but also needs to review the usefulness and relevance to the student's interests in their lives.

Looking at the problems above, it is necessary to find the methods and learning approach that directs students having the flexibility to solve the problems they face to achieve higher-level thinking aspect. One alternative learning approaches in effort to improve students' mathematical literacy is by learning the process skills approach. Skill process approach is essentially a management of teaching and learning activities that focus on student involvement actively and creatively in the process of acquiring the learning outcomes (Conny, 1985). This Skill Process Approach is seen as an appropriate approach to the implementation of teaching in schools in order to deal with the fast development of science and technology these days. This Skill Process Approach is different from the conventional one, because in learning with the conventional approach, the teachers only give the subject matter focuses on providing concepts, information and facts as much as possible on the students. As a result, students' learning outcomes is only limited to the aspects of knowledge alone, while the application may not be done yet.

Dimyati (2010) revealed that the Skill Process Approach is intended to develop the abilities possessed by the students. 1) Skill Process Approach provides accurate understanding of the students about the nature of science, 2) Teaching the skills of a process means to give an opportunity for students to work with science, not merely telling or listening to stories, and 3) Using the process skills to teach science, make students learn the process and product knowledge as well.

Based on the description above, it can be concluded that the Skill Process Approach is a learning approach that leads to the development of basic capabilities in the form of mental physical and social to find facts and concepts as well as the development of attitudes and values through a learning process that enables the students to be able to improve certain skill on students , this goes along with the indicators to be achieved in improving students' mathematical literacy. So through learning by using Skill Process Approach, it is expected to increase students' mathematical literacy.

Based on the background and importance of the issues raised, the issues examined in this study are: (1) Whether the increase of students' mathematical literacy who receive learning by mathematical skill process approach is better than students who receive conventional learning in terms of basics mathematical knowledge (high , medium, and low) ?, (2) Is there any interaction between learning (mathematical skill process approach and conventional) and the basics mathematical knowledge (high, medium, and low) towards the improvement of mathematical literacy ?.

PURPOSE OF THE STUDY

Literacy is the uptake of the English word 'literacy', which means the ability to read and write. In the Cambridge Advanced Learner's Dictionary Literacy is defined as: (1) Able to read and write; (2) Having knowledge of a particular subject, or a particular type of knowledge. The content and the common notion of literacy is absorbed in various fields, such as mathematics, so that the term Mathematical Literacy appeared. Mathematical literacy is the ability of individuals (the individual's capacity) to know and understand the role played by mathematics in real life, to be able to provide an assessment and consideration appropriately, utilizing mathematics to meet the needs of a person being society's constructive, caring, and willing to think (OECD , in Kusumah 2011). PISA transforms mathematical literacy principles into three components, namely components of content, process and context. The components are described by the Centre for Development and Empowerment of Teachers and Education Personnel (P4TK, 2011) as follows:

1. The Content Component

In the study of PISA, mathematical literacy component content is defined as content or material or mathematical subjects that is learned in school, that includes changes and linkages, space and form, quantity, and uncertainty data.

2. The process component

In the PISA mathematical literacy component of the process is defined as things or steps of a person to solve a problem in a particular situation or context by using mathematics as a tool so that the problem can be resolved.

3. The Context Component

In the study of PISA, mathematical literacy component context is defined as a situation which is reflected in a problem that tested which may consists of a personal context (personal), the context of the work (occupational), social context (social) and the context of science (scientific).

Learning by skill process approach is the learning process that is designed in order the students can find facts, build concepts and theories with scientific skill process and attitudes by their own way. Azhar (Dimyati and Mudjiono, 2010) revealed that students' skills process are skills for managing results and teaching-learning process which gives the widest possible opportunity to observe, classify, interpret, predict, implementing, planning research and communicate the results. According to Suwardi (2003) mathematical skills learning process is learning activities that involve different types of mathematical skill proces in obtaining, processing and applying the learning outcomes.

The purpose of skills development process is that the students are able to discover and develop their own facts and concepts as well as grow and develop attitudes and values required. The Skill Process can be measured in various ways, among others, with practice tests, written tests and oral tests. The skill process can also be evaluated based on the type of skills throughout the process and can measure the whole integrated skill process.

The Skill Process approach is a learning approach that emphasizes the integration actively of new knowledge by using basics knowledge of students before. The new knowledge will be tested how they use it in answering some questions or contextual issues. If the new knowledge successfully answers the problems encountered, then new knowledge will be stored in long term memory. It provides the students experiences that learning is not just memorizing, but also to understand so that they can apply the concepts learned. Skill process approach has basic theory that is rooted in the theory of constructivism. In this constructivism theory students are encouraged to learn actively and creatively so that students are able to construct their own knowledge or a concept.

RESEARCH METHODS

This study is a quasi-experimental research because the selection of the sample is not random, but received a sample of what their circumstances. The study design used is a Non-equivalent Control Group Design (Ruseffendi, 2005: 52). The population in this research is the students of MTs and accessibility of the population are students of MTs in District Lakbok Ciamis regency, West Java province academic year 2012/2013. The sample in this research is conducted by using purposive sampling technique. The sample used in this study is class VIIIA and VIII B of MTs. Al-Amin. The instrument used in this study is a test instrument consisting tests basics knowledge of mathematics and students' mathematical literacy tests.

RESULTS AND DISCUSSION

Description N-gain and the average standard deviation of the data based on the mathematical literacy learning and PAM category in Table 1.

Tabel 1
Normality Test Result N-gain Mathematical Literacy

Category PAM	Statistik	N-gain	
		KPM	Conventional
High	Average	0,68	0,35
	Deviation Std	0,05	0,21
	Number of Student	11	11

Medium	Average	0,61	0,22
	Deviation Std	0,10	0,15
	Number of Student	13	13
Low	Average	0,48	0,28
	Deviation Std	0,08	0,08
	Number of Student	11	11

Based on Table 1 obtained the information that on the three category of PAM student who received the learning using KPM approach got a higher improvement than students who received conventional learning. It can be seen from the average N-gain difference in mathematical literacy of students in each category of PAM, for the category of high PAM difference of 0.33; PAM category was 0.39; and PAM category under 0.20.

Then, if we see the average N-gain among PAM categories, there are also differences in the average increase in mathematical literacy of students who get learning using the approach of KPM and students who received conventional learning. In the group of students who received learning by using KPM approach, between PAM with high category and medium category there is a difference, that is 0.07; between PAM with high category and low is 0.20; and between PAM with medium and a low is 0.13.

While the students who received conventional learning, between high PAM category and medium the difference is 0.13, the category of high PAM and low is 0:07; and the category of medium PAM and low is 0.06. This fact shows that the higher the PAM students have the higher the literacy skills gained. This indicates that there is a relationship between the PAM of the students with their mathematical literacy.

To acknowledge whether there is any difference in mathematical literacy improvement of students getting KPM learning approach (experimental class) and students who received conventional learning (control group) in terms of the basics knowledge of mathematics category (high, medium and low). It is necessary to test the differences in the average score of N-gain, first thing to do is to conduct the prerequisite test of normality and homogeneity of the scores of N-gain in both classes.

1) Normality Test

N-normality test score gain mathematical literacy using the Kolmogorov-Smrnov. A summary of the results are presented in the following table.

Table 2
Normality N-gain Test Based on PAm

PAM Category	Class	*Kolmogorov-Smirnov*			Conclusion
		Statistic	df	Sig.	
High	KPM	0,241	11	0,074	Normal Distributed Data
	Conventional	0,178	11	0,200	Normal Distributed Data
Medium	KPM	0,171	13	0,200	Normal Distributed Data
	Conventional	0,189	13	0,200	Normal Distributed Data
Low	KPM	0,210	11	0,189	Normal Distributed Data
	Conventional	0,187	11	0,200	Normal Distributed Data

From Table 2 above shows that a score of N-gain students' mathematical literacy classes and class Conventional KPM has the Sig. > A = 0, 05 so that H0 is accepted. This indicates that the score data N-gain students' mathematical literacy classes and class KPM conventional had normal distribution.

2) Homogeneity Test

To test the homogeneity of variance score of N-gain mathematical literacy skills using Levene test with SPSS 16 at significance level α = 0.05. The summary of homogeneity test calculations is presented in the following table.

Table 3
Result of Homogeneity Varian Test N-gain Based on PAM

PAM Category	*Levene Statistic*	df1	df2	Sig.	Conclusion
High	26,501	1	20	0,000	Non Homogenous Varian
Medium	0,218	1	24	0,645	Homogeneous Varian
Low	0,823	1	20	0,375	Homogenous Varian

From Table 3 above shows that the score of N-gain students' mathematical literacy with high category has the Sig. less than α = 0.05, so H0 is rejected. This means that the score of N-gain students' mathematical literacy classes and KPM conventional class with high category is derived from the variance is not homogeneous. While the score of N-gain students' mathematical literacy with medium and low categories have the Sig. greater than α = 0.05, so H0 is accepted. This means that the score of N-gain students' mathematical literacy classes and class KPM conventional with medium and low categories derived from homogeneous variance.

3) Test Interaction between Learning Process and PAM

To determine whether there is an interaction between the learning (mathematical skill process approach and conventional) and the basics of mathematical ability (high, medium, and low) towards the improvement of students' mathematical literacy proposed the following hypothesis:

Hypothesis testing:

H0: There is an interaction between the learning (mathematical skill process approach and conventional) and the basics of mathematical ability (high, medium, and low) towards the improvement of students' mathematical literacy

Ha: There is no interaction between the learning (approach mathematical process skills and conventional) and the beginning of mathematical ability (high, medium, and low) towards the improvement of students' mathematical literacy

To test this hypothesis used two lanes Anova test, with the testing criteria is if the probability value (sig.) is greater than α = 0.05, the null hypothesis is accepted, and if the probability value (sig.) is less than equal to α = 0.05, the null hypothesis is rejected.

Before conducting the two lanes Anova test, the normality test and homogeneity test of variance were conducted. The calculation result of normality test, showed that the data of the improvement of students' mathematical literacy based on learning and basics mathematical knowledge category distributed normally. The result of the population variance calculation shows that the variance appeared from the non-homogeneous population. Therefore, to acknowledge whether or not any interaction between the learning process and students’ basics mathematics knowledge categories, two lanes Anova test was conducted. Two Lanes Annova Test Results shown in table 4.4

Table 4.4
Two Lanes Annova Test Result
Mathematical Literacy Improvement Based on PAM and Learning
Peningkatan Literasi Matematis berdasarkan PAM dan Pembelajaran

Source	df	*Mean Square*	F	Sig.	H_0
PAM Category	2	0,112	7,263	0,001	Rejected
Learning	1	1,659	107,958	0,000	Rejected
PAM Category*Learning (interaction)	2	0,055	3,590	0,33	Accepted

Based on Table 4.4 can be concluded that the factor category students’ basics knowledge of mathematics (PAM) has a significant influence on students' mathematical literacy. This can be seen from the F value obtained with a value of less than 0.001 significance α = 0.05. Likewise, the learning factor (mathematical skill process approach and conventional) has a significant influence on students' mathematical literacy. This can be seen from the F value is 107.958 and has a significance value is 0.000 <α = 0.05.

From the results of Anova two lanes test in table 4.4 F values was obtained for the interaction is 3.590 with a probability value (sig.) = 0.33. Because the probability value (sig.) Over 0.05 then H0 is accepted. This means there is no interaction between the learning (mathematical skill process approach and conventional) and knowledge of basics mathematics (high, medium and low) towards the improvement of students' mathematical literacy. . No interaction diagram can be seen graphically in Figure 1.

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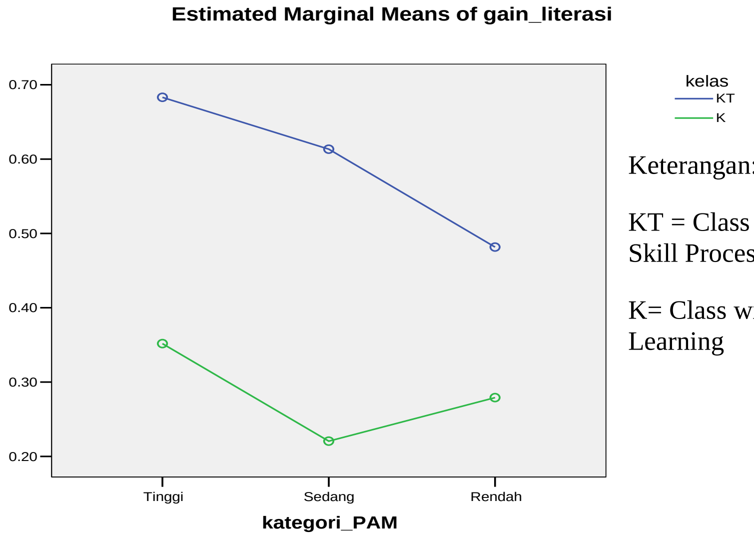

Keterangan:

KT = Class with Mathemtical Skill Process Approach

K= Class with Conventional Learning

Picture 4.1
The Interaction between Learning and PAM Category
Towards Mathematical Literacy Improvement

Regarding to the differences in the average score of N-gain mathematical literacy of students who get the learning by using KPM approach and students who received conventional learning by category initial mathematical knowledge of students of high, medium and low, respectively 0.10, 0.13, and 0, 03, shows that the learning that used KPM approach provides a greater contribution to the improvement of students' mathematical literacy as compared to conventional learning. However, when associated with basics mathematical knowledge of students (high, medium and low), the medium category gave higher contribution to the improvement of students' mathematical literacy compared to high ability and low ability students. It is obvious that in Figure 1 and the big difference in the average N-gain indicated that the difference in the average N-gain students who received learning by using KPM approach and conventional in the middle ability category was greater than the difference between the average N-gain students who received learning by using KPM approach and conventional learning in the to the high and low ability category.

4) Test Score Mean Difference N-gain based on Learning and Basics Mathematical Knowledge

Based on the results of normality test that has been done previously, it can be concluded that the score of N-gain KPM and conventional classes for all categories has a normal distribution. As for the homogeneity test showed that the scores of N-gain students 'mathematical literacy for the basics mathematical knowledge of medium and low category derived from a homogeneous variants, but for the students' mathematical literacy with high scores category is not derived from a homogeneous variant.

So to prove the existence of differences in students 'mathematical literacy improvement for each category of basics mathematical knowledge of students mathematical independent sample t-test was conducted by assuming equal variance (t test), and assuming unequal variance (t-test').

The hypothesis of the proposed research, namely:

Testing Hypothesis:

There are differences in mathematical literacy improvement of students who had a learning mathematical skill process approach is better than students who received conventional learning mathematical terms seen from basics mathematical knowledge (high, medium and low). The statistical hypothesis is formulated as follows:

H0: There is no difference in the improvement of students' mathematical literacy who received teaching process with a mathematical skill process approach with students who received conventional learning mathematical seen from basics mathematical knowledge (high, medium and low).

Ha : There a is difference in the improvement of students' mathematical literacy who received teaching process with a mathematical skill process approach with students who received conventional learning mathematical seen from basics mathematical knowledge (high, medium and low).

Here's the conclusion of the results of the mean difference test scores N-gain at significance level $\alpha = 0.05$.

Table 4.5

Difference Mathematical Literacy Average N-gain Test
Based on PAM and Learning

PAM	Learning	Average Comparison	t or t'	Sig.	Conclusion
High	KPM : Konv	0,68 : 0,35	5,065	0,00	H_0 Rejected
Middle	KPM : Konv	0,61 : 0,22	7,931	0,00	H_0 Rejected
Low	KPM : Konv	0,48 : 0,27	5,883	0,00	H_0 Rejected

Based on Table 4.5 can be concluded that for all categories of students' basics mathematical knowledge, the improvement in students' mathematical literacy who received learning by using KPM is significantly different from students who received conventional learning.

CLOSURE

Based on the data processing, analysis, findings and discussion the following conclusions as follows: (1) The improvement of students who received learning by using mathematical skill approach is better than students who received conventional learning as seen by basics mathematical knowledge (high, medium and low) (2) The learning process that used KPM approach provides a greater contribution to the improvement of students' mathematical literacy as compared to conventional learning. However, when associated with the basics mathematical knowledge of students (high, medium and low), the middle ability students category contributed higher result to the improvement of mathematical literacy if it is compared to the high ability and low ability students category. This is clearly seen from the big difference in the average N-gain indicating that students who received learning by using KPM approach and conventional in the middle ability category that is greater than the difference between the average N-gain students who received learning by using KPM approach and conventional of high and low ability category.

The recommendations from the writer are (1) The learning by using mathematical skill process approach can be used as learning mathematics, particularly to promote literacy mathematical, (2) In learning process, the use of mathematical skill process approach can create a learning climate that allows students the freedom to propose ideas , questions and issues in accordance with aspects of the skills that is developed, so teachers can use the results of research in guiding students' literacy and implement mathematical skill process approach in any mathematical subjects..

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Measuring Religiosity and Other Affective Domain with Likert and Inventory Scales in Teaching and Learning Mathematics

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***Abstract*—**Competence in mathematics learning is not only focused on the cognitive domain, but also on affective domain. In 2013 Curriculum, affective competencies mathematics consist of religiosity and other affective domain, such as self-confidence, discipline, responsibility, curiosity, and so on. One of the assessment technique used to measure religiosity and other affective domain is a self-assessment, which can be measured by a questionnaire. The questionnaire used consisted of the Likert scale and the inventory scale. The purpose of this research is to compare the measurement religiosity and other affective domain by using the Likert scale and the inventory scale. Data analysis is using descriptive analysis, paired sample t test, and Pearson correlation. The results show that (1) the average of religiosity questionnaires by using Likert scale and inventory scale are at very high category, and the average of other affective domain questionnaires by using Likert scale and inventory scale at the high category; (2) based on paired samples t-test, there was no difference between the measurement Likert scale and inventory scale for each religiosity and other affective domain's questionnaires, and (3) religiosity questionnaire correlation coefficient for Likert scale and inventory scale is 0.675, and other affective domain questionnaire correlation coefficient for Likert scale and inventory scale is 0.692, which means there is a positive correlation between the Likert scale and the inventory scale. These results indicate that measurements using the Likert scale and the inventory scale give the same results, so that it can be used as an assessment instrument in teaching and learning mathematics.

Keywords: *measurement, religiosity, likert, inventory, learning mathematics*

I. Introduction

Mathematics is the science of the abstract pattern and ideological that exist in the surroundings arranged in a hierarchical, systematic, and tiered. Mathematics courses should be given to students so that students can think logically, critical, analytical, and creative. The purpose of learning mathematics by NCTM (1989) is that the students should have the following capabilities: (1) be able to apply their knowledge to solve problems in mathematics and other disciplines; (2) capable of using mathematical language to communicate ideas; (3) capable of reasoning and analyzing; (4) to know and understand the concepts and procedures; (5) the disposition of mathematics; and (6) to understand about the nature of mathematics; integrate aspects of mathematical knowledge.

To achieve the goals of mathematics learning, mathematics learning should receive serious attention and handling. One of them is related to the assessment should be done by the teacher in the learning of mathematics. Assessment is an extremely important part and can't be separated from the learning activities. Anderson (2003) explains assessment is the process of gathering information used to make informed decisions. Then, Mardapi (2012) explains assessment is the process of gathering information about the learning achievements of learners, to be used as a basis for making decisions. The main purpose of the assessment is to improve the quality of education, because the assessment can be communicate what was expected and what has been achieved in the learning activities. The assessment results also provide feedback to learners with regard to their learning achievement.

Kellaghan & Greaney (2001) explain the assessment is the activity of collecting information about knowledge, attitudes, and skills of individual or group of learner. This opinion was reinforced by Mardapi (2012) states the assessment process includes gathering evidence about the achievement of learners are not always obtained through testing alone, but can also be collected by observation or self-assessment. This is in accordance with the CCSSO (Mikulec & Miller, 2012) states that the teacher understands and uses multiple methods of assessment to engage learners in their own growth, to monitor learner progress, and to guide the teacher's and learner's decision making. Therefore, the implementation of assessment in the classroom, teachers need to use a variety of assessments to measure the level of achievement of learner's competences. Through the assessment, teachers can contribute to a better theoretical understanding of classroom assessment and can also be useful in a practical manner as a basis for designing professional development and instruments for measuring teachers' assessment practice (Veldhuis & Heuvel-Panhuizen, 2014).

Assessment of learning mathematics in 2013 Curriculum which can be collected by observation or self-assessment is an assessment of religiosity and other affective domain. Religiosity is the religious attitude, which is a condition that comes to a person who encouraged him to behave in accordance with the level of adherence to religion (Jalaluddin, 2012). Other affective domain leads to social attitudes. Attitude competence is the expression of values or philosophy of life that is owned by someone and manifested in behavior. Other affective domain can be developed is self-confidence, discipline, curiosity, and responsibility.

The problem that occurs in the religiosity and other affective domain assessment is if the number of students in a classroom is too much, then the teacher will have difficulties to carry out an assessment by observation. The difficulty is due to the time wasted learning for observation. Therefore, it would require other assessment techniques are more effective. One technique that can be used assessment is the self-assessment.

Self-assessment is critical to many educational process (Mort & Hansen, 2010). Self-assessment is an assessment technique involves a person to take responsibility from themselves to assess and the results of their work experience. Self-assessment is also a process designed to allow a person to collect information about their own performance and compare it with the goals and the criteria for their work (Motycka, 2010). Furthermore, Reys (2009) explain that students are often the best assessors of their own work and feelings. When students evaluate their own work, the responsibility for learning is theirs. Therefore, teachers can begin the process of self-assessment by allowing student to validate their own ideas or answers results of their work.

The instruments are used for self-assessment is a questionnaire. Questionnaire developed consist of the Likert scale and the inventory scale. This paper will describe the comparison between measurement religiosity and other affective domain with the Likert scale and the inventory scale.

II. explanation

A. *Religiosity and Other Affective Domain*

Krathwohl (1964) explains affective domain can describe learning objectives that emphasize a feeling tone, an emotion, or a degree of acceptance or rejection. Affective objectives vary from simple attention to selected phenomena to complex but internally consistent qualities of character and conscience. This domain includes the manner in which deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. The five major categories are listed from the simplest behavior to the most complex, such as receiving, responding, valuing, organizing, and characterizing. Based on the categories of affective domain, affective domain that will be studied in this paper is religiosity and other affective domain, such as self-confidence, discipline, curiosity, and responsibility.

1) Religiosity

Religiosity is a unified comprehensive elements, which make a person called religious people (being religious), and not just claim to have faith (having religion). Anshori (Ghufron & Rini, 2014) explain that religiosity refers to the religious aspects of a person who has lived in the liver. Religiosity can also be interpreted as religious because of their religious internalization into oneself (Dister in Ghufron & Rini, 2014). Another opinion says that religiosity leads to thoughts, words, and actions of a person who strived always based on the values of divinity or religious teachings (Fathurrohman, Suryana & Fatriani, 2013).

Religiosity realized in various sides of human life. Religiosity does not only occur when performing ritual, but also other activities coming from internal strength. Religiosity not only the activities that can be seen, but also the activities that can't be seen and occur in person's heart (Ancok & Suroso, 2011). According to Glock & Stark (1968), there are five dimensions of religiosity: ideological, ritualistic, experiential, intellectual, and consequential dimension.

2) Other Affective Domain

Other affective domain developed in this paper are self-confidence, discipline, responsibility, and curiosity. Self-confidence is very important and needs to be instilled in a person. Self-confidence is a trait supporting one's progress. According to Yoder & Proctor (1988), self-confidence is the active, effective expression of inner feeling of self-worth, self-esteem and self-understanding. Furthermore, Anthony (Ghufron & Rini, 2014) argues that self-confidence is an attitude in a person who can accept the fact, can develop self-awareness, positive thinking, to be independent and have the ability to have and achieve everything to be desired. The confidence of someone giving someone an opportunity for them to develop themselves in order to achieve something to be desired. This was confirmed by Manning & Curtis (2003) explains that confidence is one's ability gives the leader inner strength to overcome difficult tasks.

Self-confidence is a faith or belief in one self and one's own abilities to succeed (McElmeel, 2002). It is the belief that one will act in a right, proper, or effective manner. Then, Lauster (Ghufron & Rini, 2014) explains that the confidence obtained from life experience. Self-confidence is one aspect of personality that form of belief in the ability of a person that is not influenced by others and may act according to the will, excited, optimistic, tolerant, and responsible. Someone who believes in yourself will be able to resolve the problems faced and obtained from the experience of everyday life. Based on some opinions about self-confidence, it can be concluded that self-confidence is to believe in them, bold, and not influenced by others in order to overcome or deal with the problems being faced in appropriate conditions.

Related with discipline, Freire (Yang, 2009) explain that discipline is a necessary condition for effective action in the social world. According to Savage & Savage (2010), discipline is defined as actions that facilitate the development of self-control, responsibility, and character. The definition of discipline by Savage & Savage reinforced by Martella (2012) which states that training to act in accordance with rules, instruction, and exercise design to train proper conduct or action, behavior in accordance with rules of conduct, and a set of system of rules and regulations.

According by Moenir (1987), there are two dominant types of discipline in an attempt to produce something that desired. It is discipline in terms of time and discipline in terms of deed. Both of these disciplines is an inseparable unity and mutual influence. Then, Lickona (2004) divided discipline falls into two categories, prevention and correction. Better prevention strategies will reduce the frequency of the behavior of student discipline problems, but if the problem still arises character-building strategies will be needed to overcome them. Based on some definitions about discipline, it can be concluded that the discipline is any behavior or act in accordance with the rules or the regulations, both in terms of time and deeds.

Furthermore, responsibility is one of the important character values developed in education. Stevenson (2006) explains that being responsible means that you answer for your actions. If you say, you will do something; you follow through on your promise. If you make a mistake, you admit it and take responsibility for the consequences. Another opinion expressed by Samani & Hariyanto (2012) states that responsibility means responding in a way that is proper and decent, responsible for their actions. Then, responsibility means doing the task whole-heartedly, working with high work ethics, strive to achieve the best performance, able to control themselves and cope with stress, and accountable to the choices and decisions made (Samani & Hariyanto, 2012).

According Azzet (2014), responsibility is to carry out the obligations as it should be, both toward God, oneself, society, social environment, natural surroundings, the nation and the state. It can be said that the element of responsibility is seriousness (Mu'in, 2013). Based on the above opinion, someone said to be responsible when carrying out the task of learning, seriously perform their duties, and acknowledging the wrong done.

Other developed affective is curiosity. Curiosity can provide stimulation and encouragement of students to be interested and participate in learning activities that build knowledge and training expertise (skills). Elliot (2000) explains that youngsters are naturally curious, and if their curiosity is encouraged, it will probably last a lifetime. Then, Schmitt & Lahroodi (2008) explores the value of curiosity for inquiry and knowledge. Curiosity is the desire to learn and learn something in order to get information or new knowledge. Learning is not simply knowing yet explore to find out more so as to give meaning to what is obtained in the learning process. This is accordng with the statement McElmeel (2002) argues that curiosity is a desire to learn, investigate, or know. It is an interest leading to exploration or inquiry.

Curiosity marked with the feedback that has not shown consistency in the knowledge base of students so that they will be motivated to understand what they do not know (Matheson & Spranger, 2001). Curiosity often described by various terms, but all have the intention or the same meaning. Loewenstein (Elliot, 2000) explains curiosity is a cognitively based emotion that occurs when a student recognizes a discrepancy or conflict between what he or she believes to be true about the world and what turns out actually to be true. Students are believed to feel curious about events that they can neither make sense of nor explain fully. In addition, curiosity occurs when students encounter unexpected, novel, and unpredictable objects. Together with Loewenstein's opinion, Stones (1984) explains in various experiments the satisfaction of curiosity has been found to be reinforcing, so that there does really seem to be justification for viewing the need to explore the environment as real and legitimate reinforce.

Based on the various opinions, it can be concluded that curiosity is a cognitive emotion when someone gets or conflict that led to the desire to learn, investigate, and find out widely and deeply. In behavior can be demonstrated by the activity or activities to explore, manipulate, or coordinate existing cognitive structure with a new way to understand a broader knowledge and deeper.

B. ***Likert Scale and Inventory Scale***

1) **Likert Scale**

A Likert scale is a psychometric scale commonly involved in research based on survey questionnaires. Here, the respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale for a series of statements while responding to a particular Likert questionnaire item. The range of Likert scale captures the intensity of their feelings for a given item. However, the result of analysis of multiple items reveals a pattern that has scaled properties (Barua, 2013).

McCoach, Gable & Madura (2013) defined the Likert response format has been used extensively for affective instruments. The typical 5-point agree continuum consists of ordered response alternatives such as: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD). Likert scales provide a range of responses to a statement or series of statements. Usually, there are 5 categories of response ranging from 5 = strongly agree to 1 = strongly disagree with a 3 = neutral type of response (Croasmun & Ostromt, 2011). Then, Likert item has two parts: the 'stem' statement and the 'response scale' (the answering options offered to respondents). Each item consists of a single statement of demand. There are two kinds of statements are positive statements (statements which are expected to be approved by the respondent) and negative statements (statements which are not expected to be approved by the respondent).

According by Oppenheim (1966), to produce a Likert scale we proceed as follows: first, as usual, we compose an item pool. However, for the Likert procedure it is best not to have many neutral items not many extreme items at either end of the continuum. Next, we need a sample of respondents on whom to try the items. Each respondent will be asked, not merely whether he agrees or disagrees with each statement, but to check one of the five positions given above. Respondents should be similar to those on whom the scale will be used. Next, we score the record of each respondents. To do this, we must decide whether we want a high scale score to mean a favorable or an unfavorable attitude. It does not matter what we decide, but from then on we must be consistent.

The advantages of measurement Likert scales are the Likert scales have been frequently used because they are relatively easy to construct, can be highly reliable, and have been successfully adapted to measure many types of affective characteristics (Nunnally in McCoach, Gable & Madura, 2013). While the weakness of the Likert scale is the presence of positive and negative statements, statements made can lead to a good answer or not good, especially if the statement made patterned. In a Likert scale, respondents is asked to read carefully every statement is presented, then he was asked to assess these statements. Assessment of the statements of the subjective nature, depending on the condition of the attitude of each individual.

2) **Inventory Scale**

Inventory is essentially not many different from the questionnaire. Inventory contains a number of questions that are arranged in a frame-aware of the attitudes, opinions and feelings of students to the process of conducting learning activities. Data as general information has been provided in the form of multiple choice, which should be chosen by the student.

According by Oppenheim (1966), an inventory is a list that the respondent is asked to mark or check in a particular way. It may consist of a list of interests, and the task may be to check those things that interest you a lot. In the better types of inventory, in particular those that can be properly described as personality test the items are selected after careful pilot work, and the grouping into areas is done on a statistical basic by means of correlations, so that those items that are scored together really belong together.

In contrast to measurement using the Likert scale of negative and positive statements, the inventory scale made only one question (not a statement of the positive or negative statement), which already represents the answer to the question of positive and negative statements. The inventory scale was made of five possible answers. The answer choices are given a value from 1 to 5. Techniques of value is based on a specific selection. For example, choice answers with a positive statement by a score of 5, and the answer choices with negative statements were given a score of 1.

The advantages of measurement inventory scale is a question that made does not lead to an answer is right or wrong, so that students can choose the appropriate answers to the option that best suits him. While the weakness of the inventory scale is not all the answers are in the answer choices, so that students can only choose the answer choices are approached with a choice of answers.

C. *Measuring Instrument Religiosity and Other Affective Domain with Likert and Inventory Scale*

The instrument used was a questionnaire religiosity and other affective domain by using the Likert scale and the inventory scale. Religiosity questionnaire with the Likert scale consists of 14 items and the inventory scale consists of 7 items. Other affective questionnaire with the Likert scale consists of 40 items and the inventory scale consists of 20 items.

Here is an example of religiosity and other affective questionnaire by using the Likert scale and the inventory scale.

- Examples of religiosity questionnaire using the Likert scale
  Positive statements: With prayer, I believe can work quietly repeat
  Negative statement: I feel no difference between praying or not praying before working on restating

- Examples of religiosity questionnaire using the inventory scale
  Before working tests, the benefits of praying for me is ....
  (a) note with subject matter that I have learned
  (b) it quiet in working on restating
  (c) not having any influence on me
  (d) creating reduced time in doing restating
  (e) only tradition or habit that must be done

- Examples of other affective questionnaire using the Likert scale
  Positive statement: I go to class before the bell rings
  Negative statement: I'm late to class after recess

- Examples of other affective questionnaire using the inventory scale
  Habits that I did after the recess bell is finished ....
  (a) go to class after the teacher walked into the classroom
  (b) remain in the cafeteria and was late getting to class
  (c) immediately spend on food and immediately walked into the classroom so as not to be late
  (d) stay in the cafeteria and did not go to class
  (e) immediately spend on food but did not immediately go to class

Questionnaires have met the criteria of valid and reliable. Questionnaires valid criteria based on the expert validation and construct validity, while the questionnaire reliable criteria based on the coefficient of reliability using Alpha formula. Religiosity questionnaire reliability coefficient for the Likert scale and the inventory scale is respectively 0.715 and 0.675. While other affective domain questionnaire reliability coefficient for the Likert scale and the inventory scale is respectively 0.897 and 0.789.

Questionnaires were developed subsequently tested to 1103 high school students in the city of Yogyakarta, which uses 2013 Curriculum in the second semester of the school year 2014/2015. Based on tryout results, it can be seen comparative measurements of religiosity and other affective domain by using the Likert scale and the inventory scale. Data analysis used descriptive analysis, paired sample t-test and Pearson correlation.

1) Descriptive Analysis

This analysis is done by describing the average result of religiosity and other affective domain questionnaire by the Likert scale and the inventory scale. Data description is done by converting the quantitative data into qualitative data of five scale, with reference to the formula that was adapted from Azwar (1996) in the following table.

TABLE 1. Actual Conversion Into Value Five Scale

Value	Score Interval	Category
A	$X > \overline{X}_i + 1{,}5Sbi$	Excellent
B	$\overline{X}_i + 0{,}5SBi < X \le \overline{X}_i + 1{,}5Sbi$	Good
C	$\overline{X}_i - 0{,}5SBi < X \le \overline{X}_i + 0{,}5Sbi$	Fairly
D	$\overline{X}_i - 1{,}5SBi < X \le \overline{X}_i - 0{,}5Sbi$	Poorly
E	$X \le \overline{X}_i - 1{,}5Sbi$	Not Good

With $\overline{X}_i$ = ideal mean score = $\frac{1}{2}$ (maximum score ideal + ideal minimum score), SBi = standard deviation ideal = $\frac{1}{6}$ (maximum score ideal-ideal minimum score), X = total actual score (Azwar, 1996).

The following is a descriptive analysis of religiosity and other affective domain questionnaire.

a) Religiosity questionnaire

Data conversion of religiosity questionnaire with Likert scale can be seen in Table 2.

TABLE 2. Data Conversion of Religiosity Questionnaire with Likert Scale

Score (X)	Category
$X > 56$	Very high
$46{,}67 < X \le 56$	High
$37{,}33 < X \le 46{,}67$	Medium
$28 < X \le 37{,}33$	Low
$X \le 28$	Very low

Based on the calculation, the average of religiosity questionnaire by using the Likert scale is 61.255, that are in the category of "very high".

Furthermore, data conversion of religiosity questionnaire with inventory scale can be seen in Table 3.

TABLE 3. Data Conversion of Religiosity Questionnaire with Inventory Scale

Score (X)	Category
$X > 28$	Very high
$23{,}33 < X \le 28$	High
$18{,}67 < X \le 23{,}33$	Medium
$14 < X \le 18{,}67$	Low
$X \le 14$	Very low

Based on the calculation, the average of religiosity questionnaire by using the inventory scale is 32.296, that are in the category of "very high".

b) Other affective domain questionnaire

Data conversion of other affective domain questionnaire with Likert scale can be seen in Table 4.

TABLE 4. Data Conversion of Other Affective Domain Questionnaire with Likert Scale

Score (X)	Category
X > 160	Very high
133,33 < X ≤ 160	High
106,67 < X ≤ 133,33	Medium
80 < X ≤ 106,67	Low
X ≤ 80	Very low

Based on the calculation, the average of other affective domain questionnaire by using the Likert scale is 146.040, that are in the category of "high".

Furthermore, data conversion of other affective domain questionnaire with inventory scale can be seen in Table 5.

TABLE 5. Data Conversion of Other Affective Domain Questionnaire with Inventory Scale

Score (X)	Category
X > 80	Very high
66,67 < X ≤ 80	High
53,33 < X ≤ 66,67	Medium
40 < X ≤ 53,33	Low
X ≤ 40	Very low

Based on the calculation, the average of other affective domain questionnaire by using the inventory scale is 77.677, that are in the category of "high".

Based on descriptive analysis, the average result of religiosity questionnaire using the Likert scale and the inventory scale are at very high category, and the average results of other affective domain questionnaire using the Likert scale and the inventory scale at the high category. This shows that there is no difference between measurements using the Likert scale and the inventory scale, both for religiosity and other affective domain questionnaire.

2) Paired Sample t-test

To test whether there is a difference between measurement the Likert scale and the inventory scale for each religiosity and other affective domain questionnaire, used paired samples t-test with the formula:

$$t_0 = \frac{\bar{d} - d_0}{s_D / \sqrt{n}}$$

With t_0 = value of t, $\bar{d}$ = rated from $\frac{\sum d}{n}$, d = value of the different between the Likert scale and the inventory scale, s_D = standard deviation of $\bar{d}$, n = many mambers of the sample (Walpole, 2012).

This different test is performed using SPSS 21.0 for windows. Different test results can be seen in Table 6.

TABLE 6. Significant Value between the Likert Scale and the Inventory Scale

Instrument	Significant
Religiosity	1.000

Other affective domain	1.000

Based on Table 6 was obtained that measurement of religiosity questionnaire with the Likert scale and the inventory scale significance value 1.000. This means there is no difference between the measurement of the Likert scale and the inventory scale on religiosity questionnaire. Furthermore, measurements of other affective domain questionnaire with the Likert scale and the inventory scale significance value 1.000. This means there is no difference between the measurement of the Likert scale and the inventory scale on other affective domain questionnaire.

3) Pearson Correlation

To test how the relationship between measurement the Likert scale and the inventory scale for each religiosity and other affective domain questionnaire, used Pearson correlation formula:

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$$

With r = correlation coefficient, $S_{xy} = \sum\left(X-\overline{X}\right)\left(Y-\overline{Y}\right)$, $S_{xx} = \sum\left(X-\overline{X}\right)^2$, $S_{yy} = \sum\left(Y-\overline{Y}\right)^2$, which X = value of the Likert scale, Y = value of the inventory scale (Walpole, 2012).

This correlation test was performed using SPSS 21.0 for windows. Correlation test results can be seen in Table 7.

TABLE 7. Correlation Coefficient between the Likert Scale and the Inventory Scale

Instrument	Correlation Coeeficient	Significant
Religiosity	0.675	0.000
Other affective domain	0.692	0.000

Based on Table 7 obtained information that correlation coefficient between measurement the Likert scale and the inventory scale of religiosity questionnaire is 0.675 with significance value 0.000. This means there is a positive correlation between measurement the Likert scale and the inventory scale on religiosity questionnaire. Furthermore, the correlation coefficient between measurement the Likert scale and the inventory scale of other affective domain is 0.692 with significance value 0.000. This means there is a positive correlation between measurement the Likert scale and the inventory scale on other affective domain questionnaire.

III. CONCLUSION AND SUGGESTION

Assessment techniques used to measure religiosity and other affective domain is self-assessment. Self-assessment can be measured using a questionnaire. The questionnaire used consisted of the Likert scale and the inventory scale. Based on the tryout, the result that (1) the average of religiosity questionnaires by using the Likert scale and the inventory scale are at very high category, and average of other affective domain questionnaires by using the Likert scale and the inventory scale at the high category, (2) with paired samples t-test, there was no difference between measurement the Likert scale and inventory scale for each religiosity and other affective domain's questionnaires, and (3) correlation coefficient between the Likert scale and the inventory scale for religiosity questionnaire is 0.675 and correlation coefficient between the Likert scale and the inventory scale for other affective domain questionnaire is 0.692, which means there is a positive correlation between the Likert scale and the inventory scale. This results means that there was no difference between measurement the Likert scale and the inventory scale, so that the self-assessment by Likert scale and inventory scale's questionnaire can be used by teachers.

In this founding, because the measurement by using Likert scale and inventory scale provide the same results, teachers can choose one type of scale that used in mathematics learning, particularly in assessing religiosity and other affective domains. However, there are some things need to be considered in preparing of the Likert scale and the inventory scale's questionnaire, namely (1) pay attention to the weakness for each questionnaire's type that the questionnaire is to give consistent results, (2) a statement questionnaire adjusted to students' thinking skills, and (3) the use of selection questionnaire's type, which meet the criteria of easy and practical.

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ME– 79

Analysis of Students' Ability on Mathematical Problem Solving in the Course of Mathematical Physics Through Inquiry Approach

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Abstract — The purpose of this study was to describe students' ability on mathematical problem solving after learning mathematical physics course by using the inquiry approach. The method used is descriptive method, with research subjects were students of the third semester of Physic Education of Teacher Training and Education Institute of PGRI Pontianak in the academic year of 2015/2016. The result showed that the mathematical problem solving ability of students was still relatively less with an average of 56.34. This indicates that the students have not been able to resolve physics problems using the concept of differential and matrix. In general, students were still weak in ability to communicate the results of their mathematical problem solving, which the average of this indicator was 41.30 classified as fail. While the ability of understanding and ability to use problem-solving strategies and perform mathematical procedure classified as adequate, with the averages of both indicators were 67.39 and 60.33. Students were being poor on mathematical problem solving ability was also due to the lack of mastering the concepts of physics, thus they failed in developing problem-solving strategies. This indicates that it still needs an improvement in learning by using inquiry approach, especially in questions of problem solving that given to students during the learning process.

Keywords: *inquiry approach, mathematical physics, mathematical problem solving ability*

I. Introduction

Mathematical physics course is one of the basic courses in physics education course, it is a mandatory subject for the students. The purposes are that students have the ability to formulate various physics processes into a mathematical expression and to solve analytically. Mathematical physics course develop students' ability in quantitative analytical thinking patterns based on logical mathematical reasoning in solving any problem of physics. Problems in mathematical physics course illustrate applied mathematical concepts for solving physics problems. Thus, the problems in mathematical physics course are usually a description that contains the specific physical conditions and problems to be solved.

One of the concepts in physics is discussing the mathematical swing with respect to derive a formula to determine the frequency and period of swing require an understanding the concept of ordinary differential. In addition, the formulation of the vibration period of the pendulum swing needs to be supported by Mac Laurin series, understanding Mac Laurin series is useful to explain the concept of paraxial rays. This mathematical concept is learned in the course of mathematical physics. There are still many other mathematical concepts that should be mastered by students in order to solve problems in physics. Based on this concept, to solve problems of physics required mathematical concepts, so that the mathematical problem solving ability of students is needed.

This is in line with the argument of Russefffendi [1] which argues that the problem-solving ability is very important in mathematics, not only for those who would later explore or learn mathematics, but also for those who will apply it in other areas of study and in dayly life. So the mathematical problem solving ability is not only needed by the student of mathematics, but also needed by other students who require mathematical concepts to solve problems.

Sumarmo [2] argues that problem solving is a process to overcome the difficulties encountered to achieve a desired goal. Meanwhile, Montague [3] argues that the mathematical problem solving is a complex cognitive activity that accompanied a number of processes and strategies. Dindyal [4] argues that a situation is called a problem if there are some constraints on the ability of problem solvers. The existence of these constraints cause a problem solver failure in solving problem directly. Dindyal [4] describe the problem as a situation that needs to be solved and a person does not have the tools to seek solutions.

From some of these argumentations, mathematical problem solving is a complex cognitive activity, as a process to solve a problem that is encountered and to complete a problem requires number of strategies. Practice students with problem solving in learning and not just expect them to be able to resolve the problems are given, but it is expected habits in the problem solving process allows them to live a life that is full of complex problems.

Practice students' ability on mathematical problem solving is not easy, given that to solve problems required the ability to understand the problems, determine the problem-solving strategies, solve it correctly, and restore the original settlement of mathematical problems to be solved. Therefore we need the right approach to learning, so that students have good problem-solving ability. Inquiry approach is an approach that can practice students' ability on mathematical problem-solving.

Inquiry approach is a form of teaching that emphasizes the active role of students both physically and mentally in learning process. Suparno [5] explain that the inquiry is an approach to learning that involve critical thinking ability of students to analyze and solve problems systematically. Through inquiry approach, teacher can practice students' ability to solve problems both in solving problems as well as problems encountered in everyday life.

Discovering is a part of the learning activity in the inquiry approach. The knowledge and skill that the students have to acquire, not result given set of facts, but the result of finding themselves. Lecturers should always design the program refers to the activities of finding, any content to be studied. Understanding the concepts of the course material, should be found by students and not on the ground "by the book".

Learning by inquiry approach has six stages. The first stage is the orientation, it is created an atmosphere or climate responsive learning. Students are conditioned to be ready to accept the lesson. Students are stimulated to think in solving the problem. The second stage is formulation of the problem, which begin by asking questions of the phenomena studied in learning that lead to the hypothesis (temporary answer to the problem that is being investigated). All students are asked to put forward a hypothesis, but only one hypothesis that is relevant to the concept being studied, then the hypothesis is tested by experiment or literature study.

The third stage is data collection, it is an activity in gathering the information needed to test the hypothesis. At this stage, students are given the freedom to conduct an experiment or a study on literature. The fourth stage is to test the hypothesis, which is the process of determining an answer based on data. The fifth stage is data analysis and presentation the results in writing, pictures, reports, charts, tables, and other works. The last stage is communicating or presenting the work to the readers, classmates, teachers, or other audiences.

Stages of learning by inquiry approach strongly supports the improvement student's on mathematical problem solving ability. This is evident from the aspects in assessing mathematical problem solving ability of students, namely: (1) understanding, (2) strategy, reasoning, and procedures, and (3) communication. Exemplars [6] developed a scoring rubric of mathematical problem solving ability that include such aspects as presented in Table 1.

TABLE 1. ASPECTS OF THE MEASUREMENT
MATHEMATICAL PROBLEM SOLVING ABILITY ACCORDING EXEMPLARS

Aspects of the Measurement	**Description**
Understanding	An understanding of information and mathematical concepts that are appropriate and necessary to solve the problem and check the suitability or correctness solution.
Strategy, reasoning, and procedures	The use of efficient strategies and lead to the solution of problems; shows the logical reasoning and sharp; and do accurate mathematical procedures
Communication	Effective and detailed explanation of how the problem resolved so that other people do not necessarily deduce how and why the decision was made; using mathematical representations appropriately to communicate mathematical ideas related to the solution; and using mathematical terms and notations are suitable and appropriate

Lesson activities lecture and students in the first and second stages of the inquiry approach, are the orientation stage and the formulation of problem stage. These will support the students' ability in understanding the problem in the first aspect of students' ability on mathematical problem solving. The learning activities in the third and fourth stages, such as students gather information and test the hypothesis, will support the achievement of the second aspect of mathematical problem solving ability.

Two final stages of inquiry approach, presents and communicates the results will support the achievement of the communication aspects of mathematical problem solving ability.

This study analyzed students' ability on mathematical problem solving after obtaining inquiry approach to learn mathematical physics. As has been mentioned before that the inquiry approach to learning activities in support of the achievement of students' ability on mathematical problem solving.

II. Method

This study described students' ability on mathematical problem solving in mathematical physics course after obtaining inquiry learning approach. The research is descriptive studies. The subjects of this study were the third semester students of Physics Education of Teacher Training and Education Institute of PGRI Pontianak in the academic year of 2015/2016. Technique used in the data collection were measurement and tool at data collection was form of mathematical problem solving ability test.

In general, aspects of mathematical problem solving ability are the understanding, use mathematical strategies and procedures, and communications. These aspects referred to in describing and scoring mathematical problem solving ability in this study. The description of the aspects referred to in this study are presented in Table 2.

TABLE 2. SCORING RUBRIC OF MATHEMATICAL PROBLEM SOLVING ABILITY

Aspects of the Measurement	Description	Score
Understanding	Unable to identify the data or information required to solve the problem.	0
	Can identify the data or information needed to solve the problem but wrong in making a mathematical model of the problem.	1
	Can identify the data or information required to solve the problem and be able to create a mathematical model of the problem.	2
Strategy, reasoning, and procedures	Not using of efficient strategy and leads to the solution of problem or do not solve the problem	0
	Choosing and using a problem solving strategy but wrong in doing mathematical procedure	1
	The use of efficient strategies and lead to the solution of problems; shows the logical reasoning and sharp; and doing accurate mathematical procedures.	2
Communication	No explanation of the strategy, related concepts and mathematical procedures performed; not employment of mathematical representations; and no interpretation and communication solutions.	0
	Provide an explanation of the strategy, related concepts and mathematical procedures performed; using mathematical representations; but does not interpret and communicate solutions.	1
	Provide an explanation of the strategy, related concepts and mathematical procedures performed; using mathematical representations; and interpret and communicate solutions.	2

III. Result and Discussion

Results of research on the test of students' ability on mathematical problem solving after learning by using inquiry approach during seven meetings presented in Table 3.

TABLE 3. MATHEMATICAL PROBLEM SOLVING ABILITY OF STUDENTS

Item	Understanding	Strategy, reasoning, and procedures	Communication	Score	Criteria
1	80.44	73.91	52,17	68.84	adequate
2	52.17	43.48	36.96	44.20	fail
3	84.78	80.43	63.04	76.09	good
4	52.17	43.48	13.04	36.23	fail
Average	67.39	60.33	41.30	56.34	less
Criteria	adequate	Adequate	fail		

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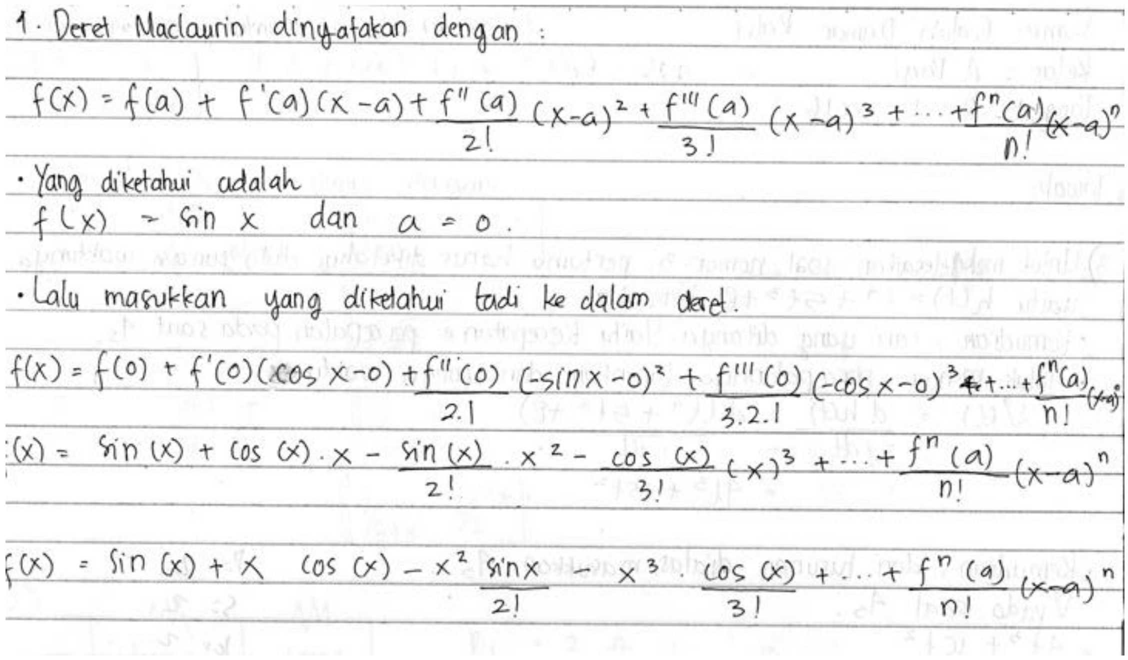
The first indicator of mathematical problem solving ability test is student can solve physics problems by using the concept of matrix, which is measured at item 1 and 2, while the second indicator is the student can solve physics problems by using the concept of derivative, which is measured at question number 3 and 4.

Based on the results of mathematical problem solving ability test in Table 3, student's ability on mathematical problem-solving is still relatively less with the average value of 56.34. The highest average value in the problem number three is 76.09 classified as good. The lowest average value in the problem number four is 36.23 classified as failed. This indicates the student has not been able to resolve physics problems by using the concept of differential, especially in determining the sequence of a function.

In question number 4 students asked to determine the Mac Laurin series of a trigonometric function at a certain point, with a given problem is: Determine the Mac Laurin series of the function $f(x)$, if $f(x) = \sin x$, to the value of $a = 0$!. Here are GDR answer in question number 4.


1. Deret Maclaurin dinyatakan dengan :

$$f(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \frac{f'''(a)}{3!}(x-a)^3 + \dots + \frac{f^n(a)}{n!}(x-a)^n$$

· Yang diketahui adalah

$f(x) = \sin x$ dan $a = 0$.

· Lalu masukkan yang diketahui tadi ke dalam deret.

$$f(x) = f(0) + f'(0)(\cos x - 0) + \frac{f''(0)}{2.1}(-\sin x - 0)^2 + \frac{f'''(0)}{3.2.1}(-\cos x - 0)^3 + \dots + \frac{f^n(a)}{n!}(x-a)$$

$$f(x) = \sin(x) + \cos(x) . x - \frac{\sin(x)}{2!} . x^2 - \frac{\cos(x)}{3!}(x)^3 + \dots + \frac{f^n(a)}{n!}(x-a)^n$$

$$f(x) = \sin(x) + x \cos(x) - x^2 \frac{\sin x}{2!} - x^3 . \frac{\cos(x)}{3!} + \dots + \frac{f^n(a)}{n!}(x-a)^n$$

FIGURE 1. GDR ANSWER TO THE QUESTION NUMBER 4

It can be seen from the work of this student, the student has to understand what is known and questioned in the problem. Students also have to choose and use problem-solving strategies but wrong in doing mathematical procedure that ultimately fail to resolve the problem.

Error in understanding the problem also results in errors on the mathematical procedure. As shown in the following WR answer in question number 4.

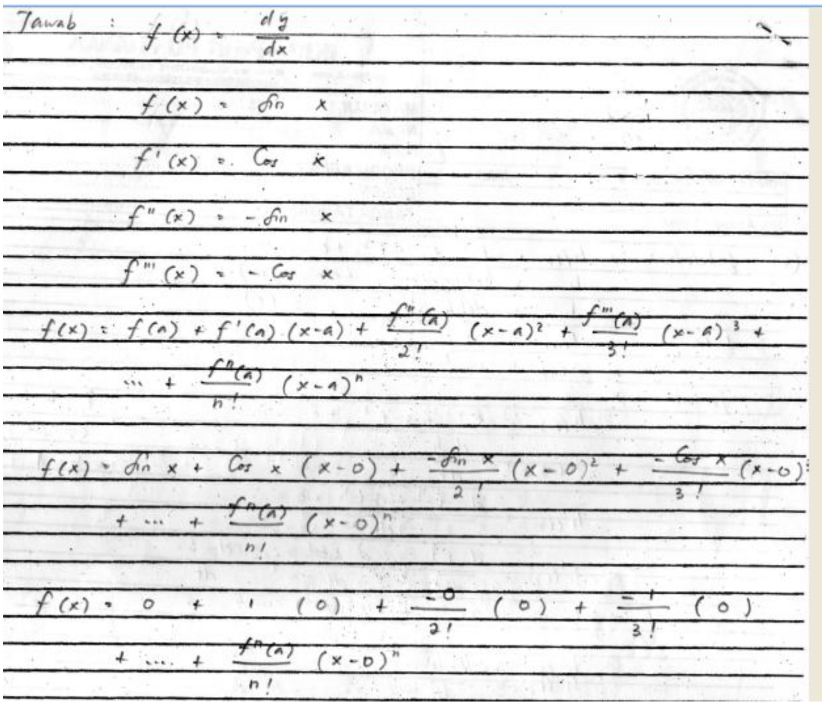
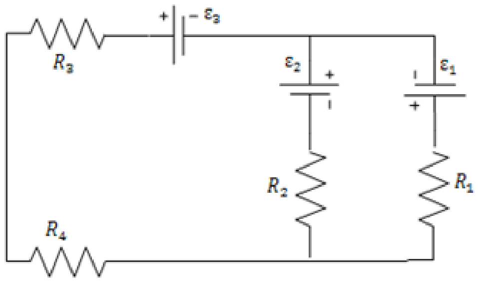


FIGURE 2. WR ANSWER TO THE QUESTION NUMBER 4

From the work of student, his work wrong in doing mathematical procedure, substituting the value of x = 0. In fact, what is known is a = 0. Students' error in understanding the problem resulted student wrong in doing mathematical procedures.

Marshal [7] states that there are some important aspects to consider in evaluating the problem solving ability. The first aspect is the mastery of factual knowledge that is relevant to the problem situation. This aspect is concerned with understanding of the problem. The second aspect is the mastery of procedural knowledge. This aspect relates to the use of strategies that fit the problem situation. The third aspect is the mastery of mathematical procedures to find solutions for problems. This suggests that to understand the problem, perform mathematical procedures, and identify and implement appropriate strategies to resolve the important aspects that need to be considered in evaluating the problem solving ability.

Question number 1 and 2 were used to measure indicators to solve problems by using the concept of matrix. In question number 2, the average was 44.20 classified as fail. This difficulty occured because students did not understand in determining the direction of the current and in determining the loop. Question number 2 is: Look at the picture series below!



In the circuit attached $R_1 = 2\Omega$, $R_2 = 4\Omega, R_3 = R_4 = 6\Omega, \varepsilon_1 = \varepsilon_2 = 3$ V, and $\varepsilon_3 = 6$ V. What current flows through each resistor? Here are answers one student YAB on the qestion number 2.

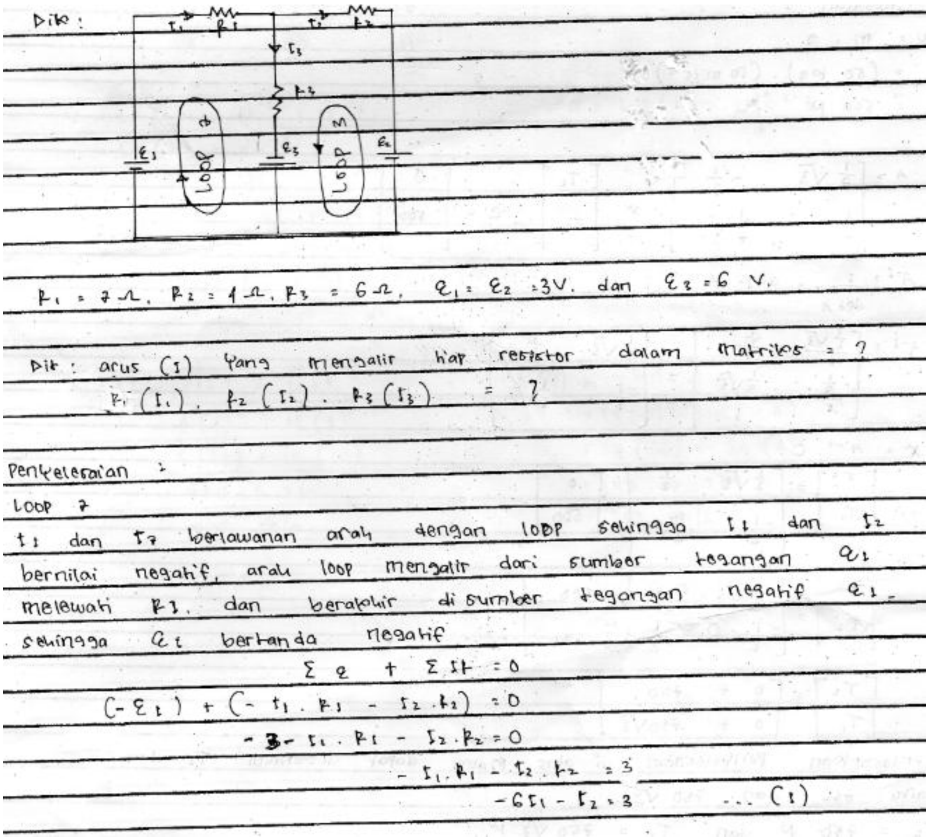


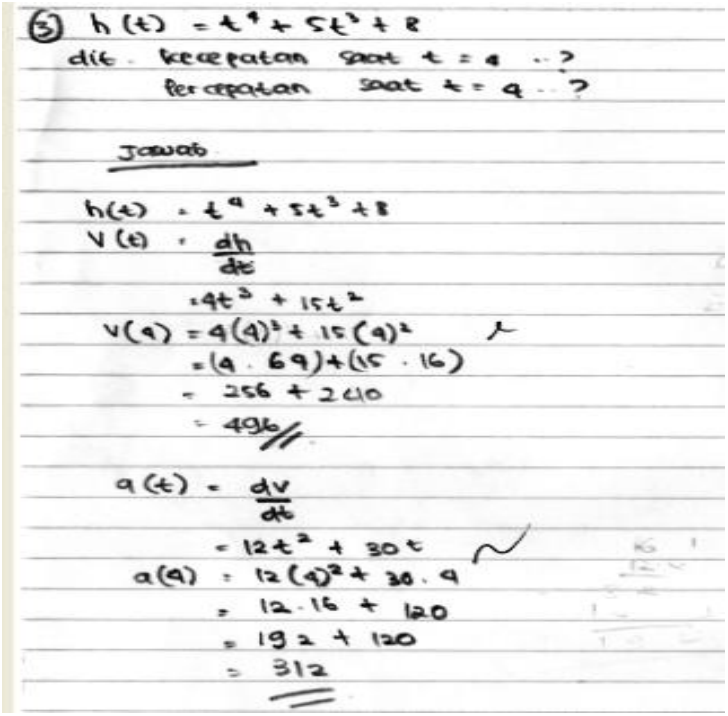
FIGURE 2. YAB ANSWER TO THE QUESTION NUMBER 2

Based on the YAB analysis, it appears that students misunderstood the current direction of the loop they describe, which is supposed to say in the direction opposite direction, so that wrong in forming the equation, prior to the use of matrix in solving the problem. In general it can be said that, the student mistaken in reading the representation of images made.

Chamberlin [8] also revealed that one of the components of problem solving is a representation, which represent mathematical ideas related to the problem in brief and simple, easy to be processed and operated and looked for a solution. Montague [3] asserts that the appropriate representation of the problem is the basis for understanding the problem and devise a plan to solve the problem. He further said that visualization is a representation of a very tough strategy, but many students do not develop the ability to use visual representations automatically for solving mathematical problems. Students need clear instructions on how to use visualization to represent the problem. Some students may use visualization, but in applying it does not fit, so it is not effective. As performed by the student, the student had to visualize, but incorrect in implementing them so that eventually one in the problem solving process.

Reviewing three indicators of mathematical problem solving ability, in Table 3, it can be seen that the students are still weak in ability to communicate the results of their mathematical problem solving, which is the average in these indicators 41.30 classified as fail. In question number 1 and 3 the ability of understanding and ability of use problem-solving strategies and mathematics procedures has been quite good, but they failed in giving an explanation of the strategy, related concepts, and mathematical procedures performed, did not use the right mathematical representation, and no or less precise in defining and communicating solutions.

Question number 3 is: Running the ball is rolling expressed by the time function $h(t) = t^4 + 5t^3 + 8$, with height of the ball in meters and t in seconds. What are the velocity and acceleration at $t = 4$ seconds. Student TK analysis below showed that the students managed to solve the problem, but without proper communication, problem solving becomes meaningless.



(3) $h(t) = t^4 + 5t^3 + 8$

dik. kecepatan saat $t = 4$ ..?

percepatan saat $t = 4$ ..?

Jawab

$h(t) = t^4 + 5t^3 + 8$

$V(t) = \frac{dh}{dt}$

$= 4t^3 + 15t^2$

$V(4) = 4(4)^3 + 15(4)^2$

$= (4 \cdot 64) + (15 \cdot 16)$

$= 256 + 240$

$= 496$

$a(t) = \frac{dv}{dt}$

$= 12t^2 + 30t$

$a(4) = 12(4)^2 + 30 \cdot 4$

$= 12 \cdot 16 + 120$

$= 192 + 120$

$= 312$

FIGURE 3. TK ANSWER TO THE QUESTION NUMBER 3

According to Jonassen [9], the ability to provide arguments to how the problem solving process is done, why a certain problem-solving strategies are used, and why the obtained solution is correct or appropriate is an important aspect in evaluating the problem solving abilities. The explanation can be done using variety of notations, terms, or other relevant mathematical representations. High scores will be given to students who are able to provide a coherent and systematic explanation.

Measuring the problem-solving ability is not only focused on the truth of substantially solutions and mathematical procedures performed, but the coherence, systematic ideas or mathematical procedures that support these solutions. Related to this, problem solving can be seen as a process of communication, which students communicate ideas or mathematical thinking, coherently and clearly.

This is in line with the opinion of McIntosh [10] which states that a new problem actually said to have been completed by a student if the student has understood what he was doing, which is to understand the process of solving the problem and understand why the solution obtained in accordance , This indicates that the reflection is a very important stage in problem solving.

Problem solving ability that has not reached the desired target would require an evaluation of the implementation of learning by inquiry approach, especially when the students are trained to solve problems. Students should be trained to: (1) understand the problem well, (2) perform problem solving procedures correctly, (3) provide an explanation of the procedure carried out in a coherent and systematic, and (4) interpret the final solution obtained.

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P – 01

Numerical Study of Material Carrier Car on a Belt Conveyor Using the Totally-Asymmetric Simple Exclusion Process with Parallel Updating and Periodic Boundary Condition

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***Abstract*—**An interesting process in material industries is the distribution process of the materials. The distribution of materials in large numbers is done using a material carrier car into silos. When the distribution of materials into one silo is full, the distribution to the next silo may be delayed. This may cause a loss to the company due to ineffectiveness and inefficiency of the distribution process. This article discusses a mathematical modeling in the distribution of materials using a carrier car towards the silos on a belt conveyor. The mathematical model utilized is the totally-asymmetric simple exclusion process (TASEP). TASEP in one dimension (1D) is a stochastic process in which hard core particles that occupy 1D lattice jump to their nearest neighbor as long as the nearest neighbor is not occupied by another particle. Using this model, the density and current density profiles of the TASEP are obtained that can describe the density and current density of the material carrier car heading to the silos. It is obtained from the TASEP model that the rate of the particle jumping is quite low.

Keywords: *belt conveyor, material carrier car, parallel updating, periodic boundary condition, TASEP*

I. INTRODUCTION

The development of industrial materials in Indonesia is followed by the demand and availability of the materials. In order to meet market demands, material industries require equipment to transport materials from the mining location to the processing plant, which is calls conveyor belt. A belt conveyor has a function to move a cargo in the form of units or bulks along a straight line or a limited angle of inclination. The movement of a belt conveyor is in the horizontal direction or forming an angle from one operating system to another operating system in one line of production processes. In addition, the belt conveyor is a machine that has a large enough capacity that is 500 up to 5000 m^3/hour or more. The conveyor belt is also able to transfer material to a relatively far distance between 500 to 1000 meter or more.

P.T. Well Harvest Wining Alumina Refinery Ketapang is a company whose productivities is in the field of purification of bauxite mining material into alumina. This company uses a belt conveyor to transport bauxite material from the mining location to the silo in the processing plant. A silo, also called a stockpile, is a place to store the bulk material. In this case, a silo is a place to store bauxite reserves in the bauxite temporary storage warehouse. To arrive at a silo, the bauxite materials are carried by a carrier car, by which the bauxite materials are poured into the silo. But the distribution of bauxite material using a conveyor belt into the silos often encounter obstacles in the form of equipment termination. Termination occurs due to the system hardware equipment which is not functioning properly. In addition, when the distribution of material into one silo is full, the conveyor belt will stop operating. These problems lead to delays in the distribution of material to the next silo.

To overcome these problems, a mathematical modelling of material distribution via a carrier car on a belt conveyor into the silo is used, namely the totally-asymmetric simple exclusion process or known as TASEP. TASEP in one-dimensional (1D) is a stochastic process in which hard core particles that occupy a 1D lattice sites move towards the nearest neighbor site as long as the neighbor site is not occupied by other particles [1,2]. The jump can occur in one direction only, i.e.: to the right or to the left. TASEP is a model of particle jumping which is used to study non-equilibrium systems. There are many scenarios given in the dynamics of TASEP such that the flow in the system is maintained. TASEP has been used to study various physics and biological phenomena, including protein synthesis [3], kinematics polymerization of macromolecules [4-6], and traffic of insects [7,8]. In addition, a wide variety of boundary conditions can be specified on the TASEP. One of them is the periodic boundary condition. The periodic boundary condition produces a ring-shaped geometry so that the number of particles in the lattice sites is constant. Thus, an equilibrium condition is obtained in the system by which particles randomly hop along the sites with the same probability. However, if the rate of the particle jumping is made inhomogeneous, a phase transition from low density to high density may occur.

In this article, the material carrier car is modeled as the hard core particle and the belt conveyor is modeled as the lattice site. Furthermore, it is assumed that the bauxite material is distributed from one silo to the next one sequentially, and experiencing some delay in the movement, so that the hard core particle has a low hopping rate to the lattice which consists of a silo. From this connection the density and current density of the particle may describe the density and current density of the material carrier car moving from one silo to another. To complete the TASEP model, a periodic boundary condition and dynamics of parallel updating are used.

The density and current density that are obtained by numerical methods using the C++ language program are based on the mean field approach (mean-field approximation). Finally, through the density and current density of the hard-core partcle, the physical behavior of the material carrier car carrying bauxite material around the silo can be studied. Hence, the objectives of this article are i) modeling the movement of material carrier car distributing bauxite materials on a belt conveyor using the TASEP model with periodic boundary condition and parallel updating dynamics, ii) determining the density and current density of one hard-core particle (material carrier car) on a lattice site (belt conveyor) with variation of distances between sites that have low hopping rates (indicating a silo) generated by the TASEP model, and iii) interpreting the density and current density of the hard-core particle as the density and current density of the material carrier car on the conveyor belt move bauxite materials into the silos.

II. METHOD OF RESEARCH

This is a theoretical research via a numerical methods. The model being studied is the TASEP. The TASEP is a mathematical model that can be used to study the dynamic behavior of a physical system. The physical systems mentioned here are systems that have moving elements (motile) and tracks in which the motile elements are moving upon. Here the TASEP is used to model the distribution system of a material carrier car on a belt conveyor which is moving bauxite materials into silos. If the material carrier car arrives in a silo, then the bauxite materials in the carrier car are transported and temporarily stored in this silo. For modeling the above distribution process, it is first necessary to build a relationship between the TASEP model and the system being studied. The linkage between the TASEP model with the system being studied can be identified as follows:

i) the carrier car is represented as a single hard core particle,
ii) the belt conveyor is represented as a lattice system, and
iii) the silo is represented as the lattice site that has a low hopping rate.

From the three relations above, one may obtain a TASEP model where there is only one particle moving on the lattice system. In accordance with the periodic boundary condition, the particle jumps from one site to the next nearest neighbor site with a specific hopping rate. In addition, the setting of parallel updating dynamics causes the particle to jump from one site to the right nearest neighbor site with certainty, except at a certain site that consists of a silo. Because a material carrier car is quite heavy as it carries bauxite materials, the speed at which the carrier car is moving over the conveyor belt can also be realized as not too fast. It also keeps the belt conveyor not easily broken. Thus, the hopping rate when the carrier car is on the silo will experience a significant decline. Therefore, in this study the hopping rate when the particle has reached the silo is $k = 0.001$. This value is still quite small when compared to the total number of iteration steps $t = 10^6$ time steps. This means that the steady state can still be met. In general, this study obtains a TASEP model where there is only a single particle hopping in the lattice system with periodic boundary condition. In addition, the hopping rate of the particle in this model is quite small, especially in the lattice containing a silo. This is what makes the TASEP modeling in this study quite interesting and different from other TASEP models.

Following the relationship between the distribution system and the TASEP above, a continuity equation is used via the TASEP model. These equations are solved numerically using the C++ language program, such that the steady state density and current density of the TASEP are obtained. Finally, from the density and current density obtained, interpretations for the distribution system are made based on the relationship aforementioned.

III. RESULTS AND DISCUSSION

In this study, one interesting thing to learn is how the distance between the lattice containing the silos influences the density and current density of the system. The distance between the lattice (silo) will be varied for two conditions, namely five silos directly neighboring (adjacent to each other) and five silos separated by a distance of five usual lattice sites between two adjacent silos. The density and current density results as a function of lattice sites are obtained from a numerical method which can be shown in succession in Fig. 1 and 2.

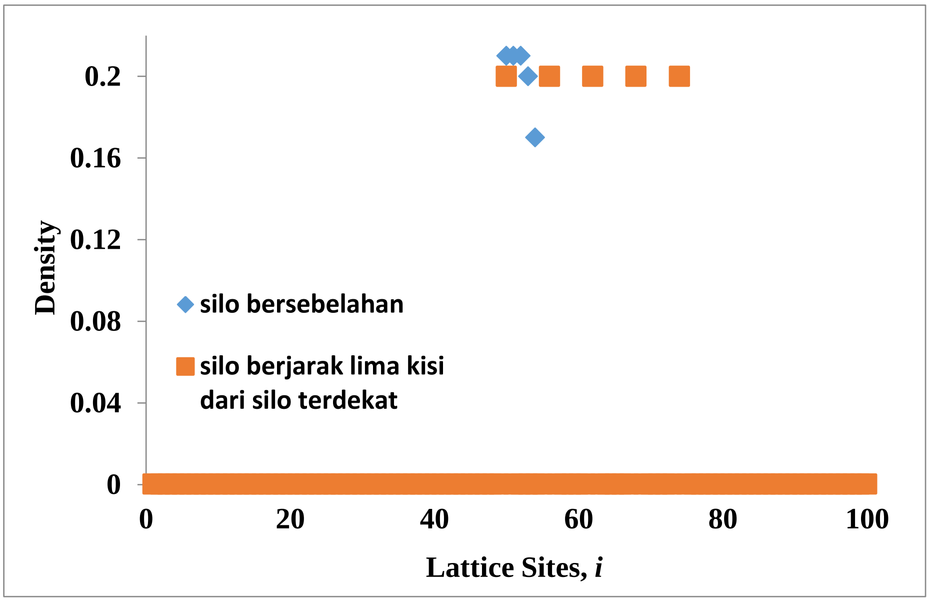

FIGURE 1. The density profile of the TASEP with parallel updating and periodic boundary condition which consists of one particle. The diamond (blue) data indicate the density profile where the lattice sites in which the hopping rate is reduced adjacent to each other. The square (orange) data indicate the density profile where the lattice sites in which the hopping rate is reduced distanced five lattice sites apart.

Fig. 1 shows the result of the numerical method for the density of a particle in the lattice system with periodic boundary conditions and variations in distance between the silos. The diamond (blue) data show the density profile for silos adjacent to one another. While the square (orange) data show the density of a particle for a silo within five lattice sites from another adjacent silo. The first silo is located in site i = 50. Generally, it can be observed that the density of the particle is very small (close to zero), either for silo adjacent or distant, except in the middle of the lattice sites. In the lattice containing a silo, the density rises to around 0.21 for the adjacent silos and 0.2 for distant silos. This shows that the distribution of the density is centered around the lattice sites that consist of silos. This makes sense, since on other lattice sites (not consisting of silos) the particle continue jumping with a hopping rate of 1.0 resulting in a low density. On the other hand, the low hopping rate on the lattice sites consisting of silos causes the density profile to be higher. Thus, the density profile in Fig. 1 is in a low density phase.

The highest density difference is fairly small between adjacent silos (ρ = 0.21) and distant silos (ρ = 0.2). This is also quite interesting. Although the difference is quite small, which is 0.01, it shows the difference in the density if the silos are adjacent to each other and when the silos are apart from one another. The difference in the density indicates that the system tends to have higher density when the silos are installed adjacent to each other than when these silos are distant to each other. In other words, the particle tends to stay longer on the silos which are adjacent to each other than when these silos are spaced. In addition, it can also be observed that the density for the adjacent silos appears more regular than the density for the distant silos. Finally, around the area of the highest density for the adjacent silos, the density plummet around the last silo.

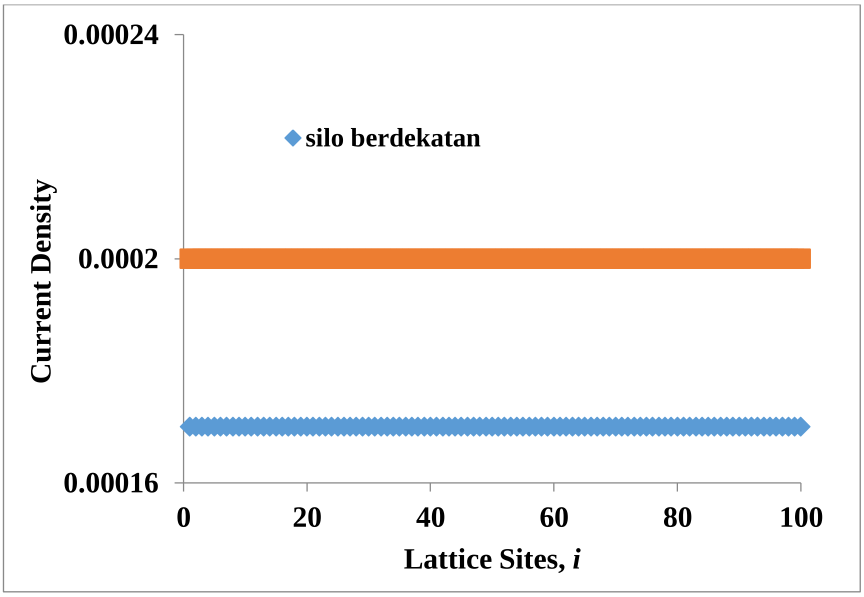

FIGURE 2. The current density profile of the TASEP with parallel updating and periodic boundary condition which consists of one particle. The diamond (blue) data are the density profile where the lattice sites in which the hopping rate is reduced are adjacent to each other. The square (orange) data are the density profile where the lattice sites in which the hopping rate is reduced are distanced five lattice sites apart.

Fig. 2 shows the current density of a particle moving in a lattice system with periodic boundary conditions and variations in the distance between the silos. The diamond (blue) data show the current density along the lattice sites for the adjacent silos. The square (orange) data show the current density along the lattice sites for distant silos. Interesting to note that the current density of the particle for the distant silos, J = 0.0002, is greater than the current density of the particle for silos adjacent to each other, J = 0.00017. This means that composing the silos distant away from each other makes the particle moving along the lattice sites become more fluent. This may be caused by the barrier faced by the particle with silos arranged apart from each other is smaller than if the silos are arranged close together. Here, the variations in the distance between the silos are made only in two variations. For longer separation distance between silos, the result of the density profile appears unchanged for the maximum density; only the distance between the density changes according to the composition of the silos.

Further discussion is given concerning the interpretation of the TASEP model. As a reminder, the system under consideration here is the distribution system of a material carrier car moving bauxite materials on a belt conveyor into silos. Following the identification above, the material carrier car transporting materials is the hard-core particle and the belt conveyor is the lattice system. Many interesting observations may be gained concerning the behavior of the material car carrier transporting materials that moves on the belt conveyor. First, the distance between the silos affects the density and current density of the material carrier car moving on the conveyor belt. Assuming the material carrier car transporting materials does not move too quickly on the belt conveyor, the greater the distance between the silos, the more fluent the material carrier car moves above the belt conveyor. Placement of silos that is too close to one another can lead to a longer time of the material carrier car to be in the area around the silos, hence making it less fluent in moving through the belt conveyor. Of course this could lead to a certain economic impact on the operating and maintenance costs of the belt conveyor system. In this case, it is recommended that, in the arrangement of the distribution system, in silos temporary storage warehouse should be placed not too close to each other.

IV. CONCLUSION

A numerical study of a material carrier car carrying bauxite materials moving on a conveyor belt into silos has been presented. The model used to study the aforementioned distribution system is the TASEP with periodic boundary conditions and parallel updating dynamics. The TASEP consists of only one particle. The result shows that varying the distance between the silos affects the density and current density of the material carrier car moving on the belt conveyor. Placing the silos further apart from one another makes the current of the carrier car more fluent than placing the silos adjacent to each other.

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P – 02

Peak Ground Acceleration for Kulon Progo Regency Based on Microtremor Measurements

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Abstract— Peak ground acceleration for Kulon Progo Regency had been determined using microtremor data taken from 38 sampling locations. Data analysis was done using Horizontal to Vertical Spectrum Ratio (HVSR) method to get pre-dominant period and Kanai method to get the peak ground acceleration value based on the pre-dominant period data. The results show that the peak ground acceleration value for Kulon Progo Regency is between 16 cm/s^2 and 61 cm/s^2. The highest value is found at Kokap and the lowest value is found at Wates.

Keywords: *Peak Ground Acceleration, Microtremor, Kulon Progo*

I. INTRODUCTION

Indonesia is located at the joint of three major active tectonic plates, they are Indo-Australia plate in the South moving northward with velocity of 7 cm per year, Eurasia plate in the North moving southward with velocity of 13 cm per year, and Pacific plate in the East moving westward with velocity of 10 cm per year. Yogyakarta is one of several cities located in the Southern part of Java island which have direct boundary to Indian Ocean and complex geologic structure. On January 25th, 2014, a major earthquake centered at 8.48 S 109.17 E (104 km northwest of Kebumen Central Java, depth of 48 km) with magnitude of 6.5 Richter Scale shook and brought infrastructure devastation such as road, electricity line and water supply. Based on the location and depth, it was caused by tectonic activity at the plate boundary between Eurasia plate and Indo-Australia plate. It was measured at intensity of III MMI in Yogyakarta [1]. Regional Disaster Management Authority (BPBD) of Kulonprogo Regency Yogyakarta noted several building had minor destruction in Galur, Kalibawang dan Lendah district after the Kebumen earthquake [2].

Kulon Progo Regency is one of many area which are prone to earthquake. However, there is no research yet about the peak ground acceleration for the area. Peak ground acceleration is the maximum ground acceleration in a location when an earthquake is taken place. This physical quantity is important because it can be used to predict the intensity of an earthquake and to determine which one of the specific area in Kulon Progo prone to the disaster. One of several method to determine the peak ground acceleration value is using the microtremor data. Microtremor is natural vibrations produced by human activities and environment. To get the peak ground acceleration from microtremor data, we can use Kanai method which consider the site's surface soil characters and earthquake parameters. The value of peak ground acceleration can be used to map the earthquake risk around Kulon Progo Regency.

II. METHOD

This research was conducted by measuring microtremor signal on 38 measurement points around Kulon Progo Regency. Measurement points was set as a grid system where each point was separated as far as 4 km. The grid occupied an area confined between 7.654 S – 7.984 S and 110.069 E – 110.274 E and representing the whole regency. The signal was measured for 30 minutes following the SESAME European Research Project guideline [3].

Equipment used in this research were TDV-23S three component seismometer, TDL-303S digital portable seismograph, Garmin Global Positioning System (GPS), compass, geology map of Kulon Progo Regency and microtremor measurement sheet from SESAME. Data analyzing was done using Mapinfo, Datapro, Sasarray-Geopsy and Surfer 11.

Microtremor signals were analyzed using Horizontal to Vertical Spectrum Ratio (HVSR) to give pre-dominant frequency (f_0) and amplification factor (A). Peak ground acceleration then can be calculated from pre-dominant frequency and Kebumen January, 25th 2014 earthquake data using Kanai method.

III. RESULTS AND DISCUSSION

Based on data analysis, we get map of pre-dominant frequency (Figure 1) and peak ground acceleration (Figure 2).

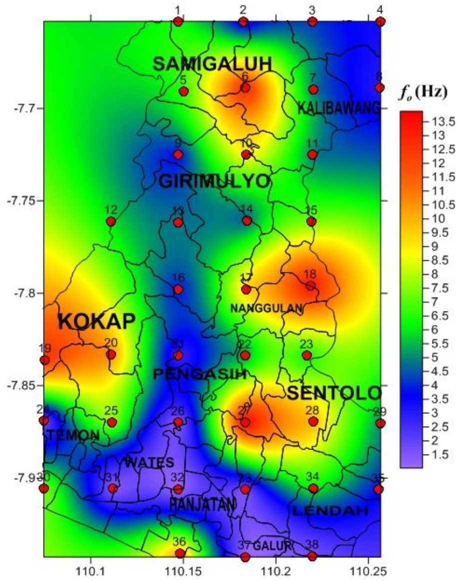

FIGURE 1. PRE-DOMINANT FREQUENCY DISTRIBUTION

As can be seen from Figure 1, the predominant frequency are higher in some measurement points and lower in other points. The highest value obtained is 14.08 Hz at measurement point 27 (Pengasih district) and the lowest value is 0.96 Hz at measurement point 32 (Wates district). High frequency means the area can produce more vibration within a period of time thus the displacement is small to produce such frequency, whereas lower frequency means the area can produce less vibration within a period of time thus the displacement is big and prone to infrastructure destruction. High frequency value usually is found in hard soil and thin sediment area, while low frequency value usually found in soft soil and thick sediment area. This explanation match quite well with the soil characters in the measurement points.

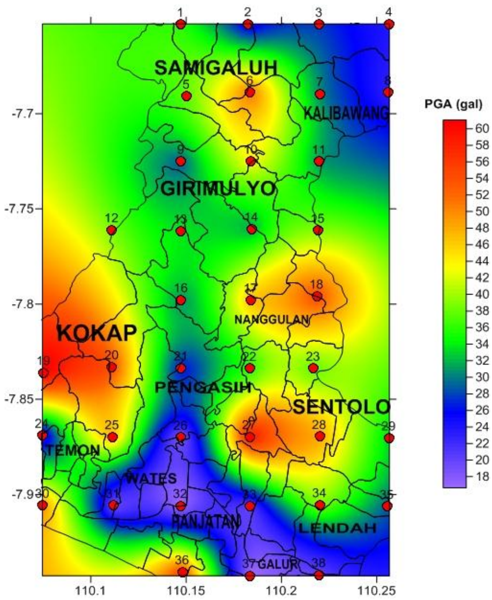

FIGURE 2. PEAK GROUND ACCELERATION (PGA) DISTRIBUTION

From predominant frequency and earthquake parameter from Kebumen earthquake, we can get the peak ground acceleration for the measurement points. The peak ground value range is between 16 cm/s^2 and 61 cm/s^2. The highest value is found at measurement point 19 (Kokap subdistrict) and the lowest value is found at measurement point 32 (Wates subdistrict). Figure 2 shows that Samigaluh, Kokap, Nanggulan and Sentolo district have higher value of PGA, while Kalibawang, Pengasih, Wates, Panjatan, Galur and Lendah have lower value of PGA.

IV. CONCLUSION

Based on the data and discussion, we can conclude that:

1. The value of predominant frequency found in the microtremor measurement is distributed between 0.96 Hz – 14.08 Hz. The highest value is found at Pengasih and the lowest value is found at Wates.
2. The value of Peak Ground Acceleration (PGA) for Kulon Progo Regency is distributed between 16 cm/s^2 and 61 cm/s^2. The highest value is found at Kokap and the lowest value is found at Wates.

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P – 03

The Effect of Alum Layer in The Construction of Biosand Filter As A Method To Manage The Laundry Wastewater

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Abstract**—**Water pollution increases with the increasing of human needs for clean water. Poor wastewater management is one of the causes of water pollution. Wastewater are produced from household waste, industrial and many others. One method of wastewater management is the biosand filter. In this research the biosand filter was designed and constructed as a tool to manage wastewater that was produced in laundry processes. Biosand filter used in this study is composed of fine sand that has been heat treatment in the oven at 200^{o}C, gravel, black fibers of *Arenga pinnata*, and foams. In this study the using of alum in biosand filter layer was also investigated. The results obtained from this research are the wastewater from laundry has a value of acidity of 9.2, but after being filtered by the Biosand Filter with the layer of alum the value of acidity dropped to 3.4, meanwhile the water that is filtered by biosand filter with no alum layer has the value of acidity of 7.0 which is categorized as neutral. These result indicates that the biosand filter with no alum layer is an effective method to manage household wastewater

Keywords: *biosand filter, wastewater management, alum*

I. INTRODUCTION

The need for water has increased three times than the growth of world population. While the facilities of wastewater processing so it can be reused is extremely limited. The situation is aggravated by the increase of water pollution[1-3]. One impact of the increasing of population and decrasing of water resources due to climate change is the need to recycle the water so it can be reused. Recycled water can be used for agriculture or plantations. Reuse of wastewater in agriculture and plantations require special attention to protect the environment [4]. Several water treatment in the household such as filtration, flocculation, chlorination and solar disinfection proven effective in improving water quality [5].

Filtration technology using biosand is one of the water management system that can be applied in the household because of the practical and economical. Biosand filter consists of a layer of fine sand and gravel and the diffuser plate that serves to protect the sand so as not to dissolve and to be in the container and serves to filter water [5]. Biosand filter water filtration technology is modified from slow sand filters for household use. The working principle of BSF begins with the raw water flowing from the top where the diffuser plate is located above the layer of sand and dampen water at a flow rate that can be regulated. Setting the flow rate is an important factor to prevent the disturbance of the biosand layers such as dissolution of the sand layer to the layer below. The water then flows slowly through layers of sand, gravel and flowing out through a pipe located at the bottom [1]. The physical mechanismsin filtration include particle capture mechanism and adsorption [6].

Based on research conducted by Mahlangu et al, (2011), the performance of biosand filter to reduce water contaminants (% removal) on physical parameters - chemical, namely (1) the elements calcium by 80%; (2) magnesium by 89%, (3) the iron by 99%; (4) arsenic by 55%; (5) The turbidity of 96%; (6) Nitrate by 37% and (7) the total organic carbon (TOC) of 41% with a filter flow rate of 1.74 liters / hour to 19, 20 liters / hour. From the bacteriological parameters, biosand filter can reduce the bacteria E. coli average of 94% (Stauber et al, 2006) and phage bacterio by 70% (Elliot, M.A., 2008) of a body of water with a water flow rate of 40 liters / day. While total coliform reduction efficiency by Baumgartner et al. (2007), the BSF can reduce total coliform samples of water bodies by 58.3 to 99.7% [7-9].

This study is focused on constructing biosand filter system that is used to manage wastewater household laundry. Biosand Filter composed of materials such as sand, gravel, fibers, alum, and foam. In this study, household laundry effluent treatment intended to be processed so it can be used in agriculture and plantations. Wastewater that have alkaline characteristics will be dangerous if directly applied to the plants, because the alkaline water will make the soil to have alkaline characteristics. The main problem in alkaline soils is reduced availability of nutrients, particularly micronutrients. Reduction of iron can also occur due to the high pH value [10]. Alum has been widely used for water purification and can lower pH levels. This study will compare the use of biosand filter with and without alum and its effect on the pH of wastewater used washing. For preliminary study pH levels of biosand filter processing result will be checked.

II. METHODOLOGIES

This research was carried out by two kind of filtration method by means of which the Biosand Filter media consist of alum and without the alum. The using of two biosand filter because the focus is how to neutralize the pH of wastewater so it can be used to watering the plants.

The materials used in this research are:

1. Media filters such as foams, fibers, alum, fine sand that has already been heat treatment with the oven at 200^{o}C for 1 hour, and gravel.
2. Waste water laundry.

The flowchart of this research is depicted in Figure 1.

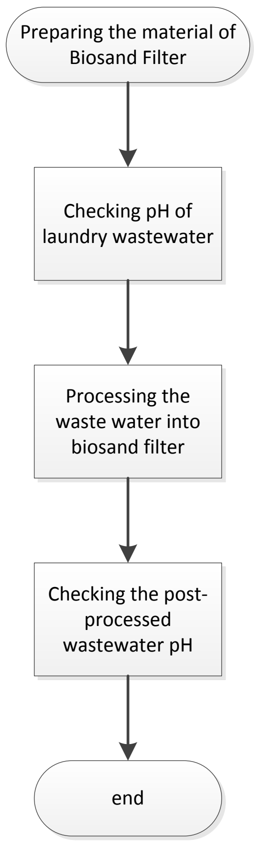

FIGURE 1. Research Flow Chart

The construction of Biosand Filter with alum that is used in this research is depicted in FIGURE 2.

FIGURE 2. BIOSAND FILTER COMPOSITION

The construction of biosand filter without the alum is the same as in FIGURE 2 except now the layer of alum has been removed.

III. RESULT AND DISCUSSION

In the first step all materials of Biosand Filter were washed in clean water. Before processed in biosand filter, the wastewater of household laundry pH were measured and the pH meter reading was 9.2 which means the water is alkaline. After pH testing the water processed in biosand filter. The first biosand filter was using alum and after biosand filtering the pH dropped to 3.4 that is indicated the water is acid. The result of biosand filtering shows in Fig.2

(a) (b) (c)

FIGURE 3. (a) the color of waste water laundry before processed in biosand filter. (b) the color of waste water laundry after processed in biosand filter with alum. (c) the pH value after biosand filter with alum processed

Because of the low pH then the water processed in biosand filter without the alum and after the filtering the water become neutral (pH 7.0 from 9.2) as seen in FIGURE 4.

FIGURE 4. THE PH VALUE AFTER BIOSAND FILTER WITH ALUM PROCESSED

The Comparison pf pH from biosand filter with and without alum can be seen in TABEL 1.

TABEL 1. PH COMPARISON

pH wastewater laundry	*pH after biosand process with alum*	*pH after biosand process without alum*
9.2	3.1	7.0

After filtering process with an without the alum both of wastewater have has changed its color to more clean ones. On filtration with granular media, there is a filtration mechanism as follows: a. Filtering mechanically (mechanical straining) b. Sedimentation c. adsorption or electrokinetic force. D. Coagulation in the filter bed e. biological activity. Filtration depends on adsorption. Adsorption is the process of particles sticking onto the surface of the individual filter grains or onto the previously deposited materials. Forces that attract and hold particles to the grains are the same as those that work in coagulation and flocculation[11]. The function of alum in this research is as coagulant that can hold the particles and purify waste water. But it can be seen that without the alum the waste water also changed its color into a clear one. Meanwhile the value oh pH of waste water after processed in biosand filter with alum shows that the water now become acid. On the contrary the non-alum waste water is neutral. The reason is because alum (aluminum sulfate; Al2(SO4)3.14H2O) is acidic in water and can reduce total alkalinity and pH by neutralizing carbonate and bicarbonate compounds with a greater decline in pH when applied to water with low initial total alkalinity [12].

IV. CONCLUSION

The results obtained from this research are the wastewater from laundry has a value of acidity of 9.2, but after being filtered by the Biosand Filter with the layer of alum the value of acidity dropped to 3.4, meanwhile the water that is filtered by biosand filter with no alum layer has the value of acidity of 7.0 which is categorized as neutral. These result indicates that the biosand filter with no alum layer is an effective method to reduce the pH so it can be reused.

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P – 04

The Accuracy Of Ore Reserves Estimation
Case Study : Laterite Nickel Deposits

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Abstract--- Determining the accuracy of the estimated ore reserves become one of the most important things in order to reach the effectiveness exploration and optimization of reserves utilization. Improved accuracy of the estimated value of the ore reserves is directly correlated with the stages of exploration, the higher of exploration the greater of the accuracy value. In this paper, the accuracy value is calculated base on of the data validation, treatment of data analysis, and ore resource estimation methods. The accuracy value so related to the scaling theory (schaling methods), the theory of weighting (weighting value), and theories of probability and accuracy. The case study conducted on lateritic nickel reserves is based on a cut-off grade (lowest average grade), nickel reserves statement with the estimated of accuracy value.

Keywords*: ore reserves estimates, the accuracy, the statement reserves*

I. INTRODUCTION

Stages of mining activities, especially ore body start from the determination of activities prospected area (prospecting), the quantity and quality (exploration), feasibility of mining operation (exploitation), processing metallurgically (processing), and marketing (marketing). The linkages of mining activities require a whole series of data accuracy, either at the time of data acquisition and processing, data analysis and interpretation.

The existence of ore body, known as the genesis of ore body, is unique and specific due to the specific parameter form (e.g levels of a precipitate), is strongly influenced by the presence of other minerals forming parameters (heat, temperature, and others). Therefore, the accuracy of determining the location of the sample, the amount of samples, and gathering sample and sample treatment procedure (sampling techniques) are a requirement that must be met.

A. Resources and Reserves

Classification of resources and the reserve has been published by the Australasian IMM / AMIC base on classification accuracy improvement and the results of geological investigations (Table 1).

TABLE 1. AIMM/AMIC CLASSIFICATION OF IDENTIFIED MINERALS RESOURCES

Identified mineral resources (in situ)	Ore reserves (mineable)	Increasing level of geological knowledge and confidence
Inferred		
Indicated ⟷	**Probable**	
Consideration of economic, mining, metallurgical, marketing, enviromental, social and govermental factors		
Measured ⟷	**Proved**	

Sources : Mineral Deposit Evaluation, A.E. Annel (1991)

Table 1 indicates that the increased resources into reserves to account for economic factors, mining, processing, market, environment, and government regulation.

Base on Table 1, Diehl and David in A.E. Annels (1991) develop a classification of ore deposits involves a degree of uncertainty (assurance) and degree of accuracy (error tolerance) for each of the different deposits. It was stated comprehensively in Table 2 below.

TABLE 2. ORE RESERVE CLASSIFICATION

Identified				Undiscovered	
Demonstrated					
Measured		Indicated (Possible)			
Proved	Probable		Inferred	Hypothetical	Speculative
± 10%$^{*)}$	± 20%	± 40%	± 60%		
> 80%$^{\$)}$	60-80%	40-60%	20-40%	10-20%	< 10%
Economically significant resources				Resources base	

*) : *Error tolerance* $) : *Assurance*

The concept of accuracy value in ore resource and reserves can be expressed with :

1. In the mining production actual stage :
   - Accuracy value = 100% - percentage error
   - Error = true quantity of reserve – true quantity of mining production
2. In the ore reserves estimation stage :
   - Accuracy value = 100% - percentage error
   - Error = convergence value can be reached in iterative methods

B. Ore reserves estimation methods

One of ore reserves estimation methods is called as block model. If the block is divided into a mesh of small blocks, the caclculation would be made for each block and the result summed. The tonnage of each block can be easily found from the block volume (the same for all block) and the tonnage factor.

Tonnage = block volume x tonnage factor (grade)

Two techniques for tonnage factor :

1. If the block have tonnage factor (grade) from the log bor, the tonnage factor can be estimated with the formula :

$$\bar{g} = \frac{\sum_{i=1}^{n} g_i}{n} \geq COG \qquad \text{COG = Cut Off Grade}$$

2. If the block no have tonnage factor (blank block), the tonnage factor can be estimated same with grade of the nearest block from the blank block.

II. SCALE OF THEORY

A. Error Formula

In general, error can be introduced as *Error = True Value - Approximate value*. The error may be divided into following different types : inherent error, round-off error, trunction error, absolute error, relative error, and percentage error.

$$E_p = 100.E_r = 100\left|\frac{x - x'}{x}\right| = \frac{E_a}{True Value}$$

where : E_p = Percentage Error ; x = true value
E_r = Relative Error ; x' = approximate value
E_a = Absolute Error

Let X = f(x_1, x_2, x_3, ..., x_n) be the function having *n* variables. To determined the error δX in X due to the error $\delta x_1, \delta x_2, \ldots\ldots\ldots, \delta x_n$ in x_1, x_2, ..., x_n respectively.

$$X + \delta X = f(x_1 + \delta x_1, x_2 + \delta x_2, \ldots\ldots\ldots, x_n + \delta x_n)$$

using Taylor's series for morre than variables :

$$X+\delta X=f(x_1,x_2,\ldots\ldots,x_n)+\left(\delta x_1\frac{\partial X}{\partial x_1}+\delta x_2\frac{\partial X}{\partial x_2}+\ldots\ldots+\delta x_n\frac{\partial X}{\partial x_n}\right)+$$
$$+\frac{1}{2}\left[(\delta x_1)^2\frac{\partial^2 X}{\partial x_1^2}+(\delta x_2)^2\frac{\partial^2 X}{\partial x_2^2}+\ldots+(\delta x_n)^2\frac{\partial^2 X}{\partial x_n^2}+2.\delta x_1.\delta x_2\frac{\partial^2 X}{\partial x_1.\partial x_2}+\ldots\right]+\ldots$$

error $\delta x_1,\delta x_2,\ldots\ldots,\delta x_n$ all are small so that the term containing $(\delta x_1)^2,(\delta x_2)^2,\ldots\ldots,(\delta x_n)^2$ and higher power of $\delta x_1,\delta x_2,\ldots\ldots,\delta x_n$ are being neglected.

Therefore $X+\delta X=f(x_1,x_2,\ldots\ldots,x_n)+\left(\delta x_1\frac{\partial X}{\partial x_1}+\delta x_2\frac{\partial X}{\partial x_2}+\ldots\ldots+\delta x_n\frac{\partial X}{\partial x_n}\right)$ .... (1)

$$\delta X=\delta x_1\frac{\partial X}{\partial x_1}+\delta x_2\frac{\partial X}{\partial x_2}+\ldots\ldots+\delta x_n\frac{\partial X}{\partial x_n} \qquad (2)$$

Equation (2) represents the general formula for errors.

If equation (2) divided by X, is called relative error, $E_r=\frac{\delta x_1}{X}\frac{\partial X}{\partial x_1}+\frac{\delta x_2}{X}\frac{\partial X}{\partial x_2}+\ldots\ldots+\frac{\delta x_n}{X}\frac{\partial X}{\partial x_n}$

Absolute value for equation (2), is called absolute error , $|\delta X|=\left|\delta x_1\frac{\partial X}{\partial x_1}\right|+\left|\delta x_2\frac{\partial X}{\partial x_2}\right|+\ldots\ldots+\left|\delta x_n\frac{\partial X}{\partial x_n}\right|$

B. Convergence of Iterative Methods

Convergence of an iterative methods is judges by the order at wich the error between successive approximations to the root decreases. The order of convergence of an iterative methods is said to be *k*th order convergencet if *k* is the largest possitive real number such that :

$$\lim_{i=\infty}\left|\frac{e_{i+1}}{e_i^k}\right|\le A$$

where : A is non-zero finite number called asymptotic error constant
e_{i+1} and e_i are the the error in successive approximations

Inthe other word, the error in any step is proportional to the *k*th power of the error in the previous step. Physically, the *k*th order convergence means that in each iteration, the number of significant digits in each approximation increases *k* times.

C. Scale of Accuracy

From the scalling methods theory, the scale of accuracy applied on 5-scale methods with the createria (see Table 3)

TABEL 3. ACCURACY VALUE

Scale	Value	Accuracy	Criteria
5	81 – 100	Very Strong	The linkage between the components of the technical approach are in line (cohesive) with standard scientific concepts
4	61 – 80	Strong	Lower than 5 scale
3	41 – 60	Moderate	At most there are three technical components of the approach is scientifically
2	21 – 40	Less Accurate	Lower than 3 scale
1	0 – 20	Not Accurate	No procedure

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III. CASE STUDY

The case study conducted on lateritic nickel reserves is based on a cut-off grade (lowest average grade).

1). Characteristics of Nickel Ore

Reserve estimation carried out simulations on the " X nickel deposits". Exploration activity that has been done is taking samples with a regular distance of 25 m by using a rotary drilling tool. Topography of the hills with a slope of 30^0-50^0 and 50-230 meters above sea level (mdpl).

Based on how the formation, geology of ore deposits is a nickel laterite ore, mineral deposit is the result of the weathering of ultra basic rock peridotite, in general, contain elements of iron, cobalt and klorium.

This ultramafic rock outcrops generally have undergone weathering, yellow-brown mottled gray, black or white with a greenish tint on the outer edge or rim. In this area there are also small cracks, fractures are commonly filled by secondary minerals (silica and magnesite).

In general profiles ore deposits in the study area, Figure (1), are as follows:

a. Top Soil, ground cover is reddish brown, there are the rest of the herbs.

b. Limonite, is the result of weathering of the soil soft yellowish brown color containing nickel and iron in the ratio is not necessarily.

c. Saprolite, is highly weathered soils have yellowish brown to greenish with many veins garnierit and onyx, has a relatively high nickel content.

d. Bed Rock, a peridotite host rock that has not weathered serpentinite.

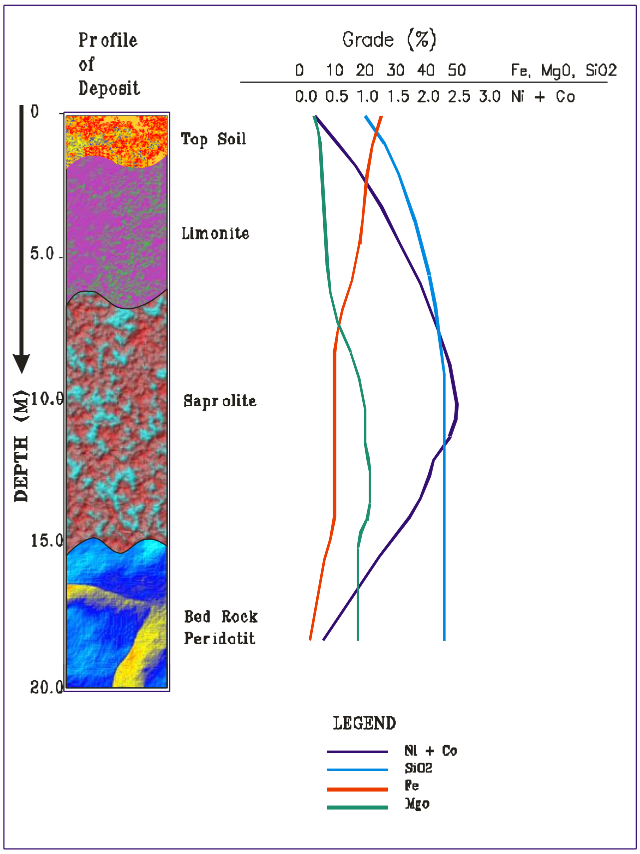

FIGURE 1. NICKEL ORE DEPOSITION PROFILE

2) Simulation

Computing applications Cut - Off Grade (COG) lowest grade = 1.7 % Ni and reserve estimation applied to one drill hole samples 1559B along with the drill log results (Table 4), is a layer that can be mined ranging depth (level) 4 m to 14 m , with an average content value :

$$COG = \frac{(1{,}93 + 2{,}10 + 2{,}32 + 1{,}77 + 1{,}39 + 1{,}47 + 2{,}13 + 1{,}75 + 1{,}21 + 1{,}18 + 2{,}20)}{11} = 1{,}768\%$$

TABEL 4. LOG BOR DATA NO. 1559B

E	N	Elev.	Level (m)	Ni	LP
3038	-2250	199	1	0.78	625
3038	-2250	199	2	0.66	625
3038	-2250	199	3	1.12	625
3038	**-2250**	**199**	**4**	**1.93**	**625**
3038	**-2250**	**199**	**5**	**2.10**	**625**
3038	**-2250**	**199**	**6**	**2.32**	**625**
3038	-2250	199	7	1.77	625
3038	-2250	199	8	1.39	625
3038	-2250	199	9	1.47	625
3038	**-2250**	**199**	**10**	**2.13**	**625**
3038	**-2250**	**199**	**11**	**1.75**	**625**
3038	-2250	199	12	1.21	625
3038	-2250	199	13	1.18	625
3038	**-2250**	**199**	**14**	**2.20**	**625**
3038	-2250	199	15	1.04	625
3038	-2250	199	16	1.41	625

When used levels of the lowest average (*moving average mean*) will get :

- Level 3 m will also be mined obtained average level COG = 1.714 % Ni , meaning that there is a level above that may come into mineable reserves are drawn so that the number will be more and more .
- Level 15 m participate mined , the average grade obtained COG = 1.707 % Ni , meaning that there is a level above that may come into mineable reserves are drawn so that the number will be more and more .

Similarly, the simulation is done by adding a level above or below, to obtain the average level over a specified COG .

From borehole data is available , it can be simulated estimated reserves. The estimated reserves are calculated based COG 1.6 %Ni and COG 1.8 %Ni ; with variations of the block size of 100 x 100 m , 75 x 75 m , 50 x 50 m , 30 x 30 m , 25 x 25 m , 20 x 20 m and 15 x 15 m . The results of the reserve calculation using the block method of nickel ore tonnage obtained respectively as shown in Table 5 below :

TABEL 5. THE TOTAL TONNAGE NICKEL ORE AVERAGE BASED ON THE LOWEST LEVEL

No	**COG (%Ni)**	**Grade (%Ni)**	**Tonnage (tons)**						
			100x100m	**75x75m**	**50x50m**	**30x30m**	**25x25m**	**20mx20m**	**15mx15m**
1.	1.6	1.71	2,023,200	2,033,300	2,041,250	2,046,075	2,050,100	2,054,050	2,058,010
Error				**0.499**	**0.391**	**0.236**	**0.197**	**0.193**	**0.193**
2.	1.8	1.87	1,452,000	1,463,510	1,471,205	1,476,300	1,480,520	1,484,000	1,487,480
Error				**0.793**	**0.526**	**0.346**	**0.286**	**0.235**	**0.235**

From Table 5 for the average level of 1.6 %Ni , error value obtained by 0.193 the value already has a relatively constant tendency (convergent) ; the accuracy of calculation of 0.807 or 80.7 % . As for the average level of 1.8 %Ni obtained an accuracy of 76.5 % . The tendency of the error value is relatively constant (convergent) also can be seen in Figure 2 and 3 below.

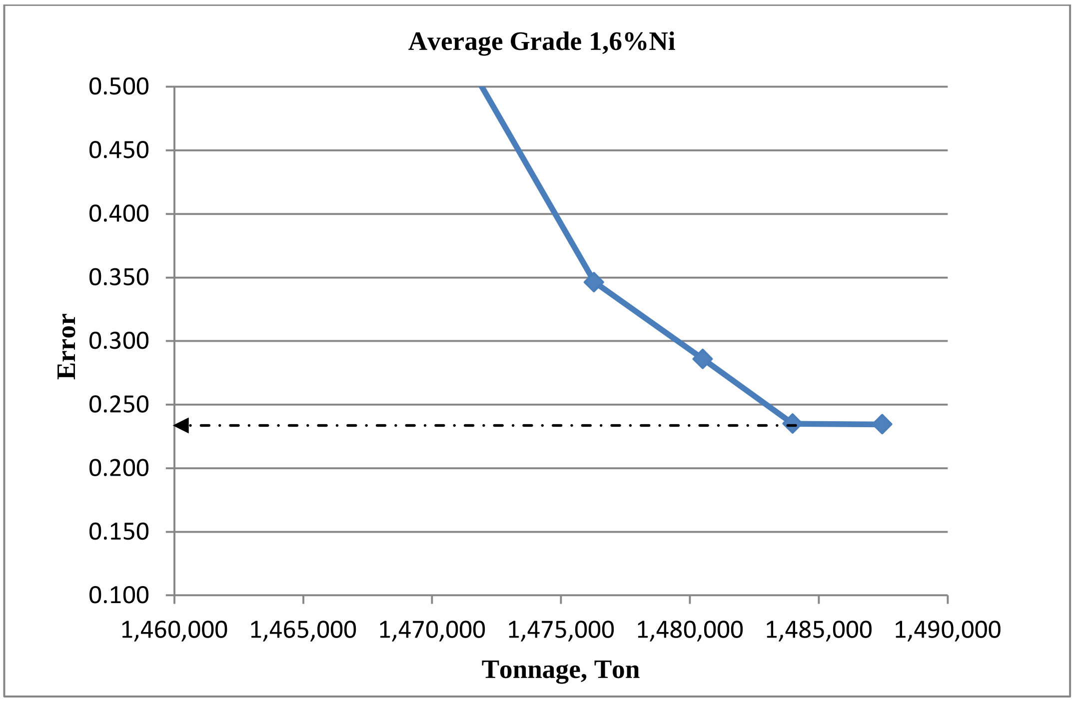

FIGURE 2. VALUE OF ERROR IN AVERAGE GRADE 1.6 % Ni

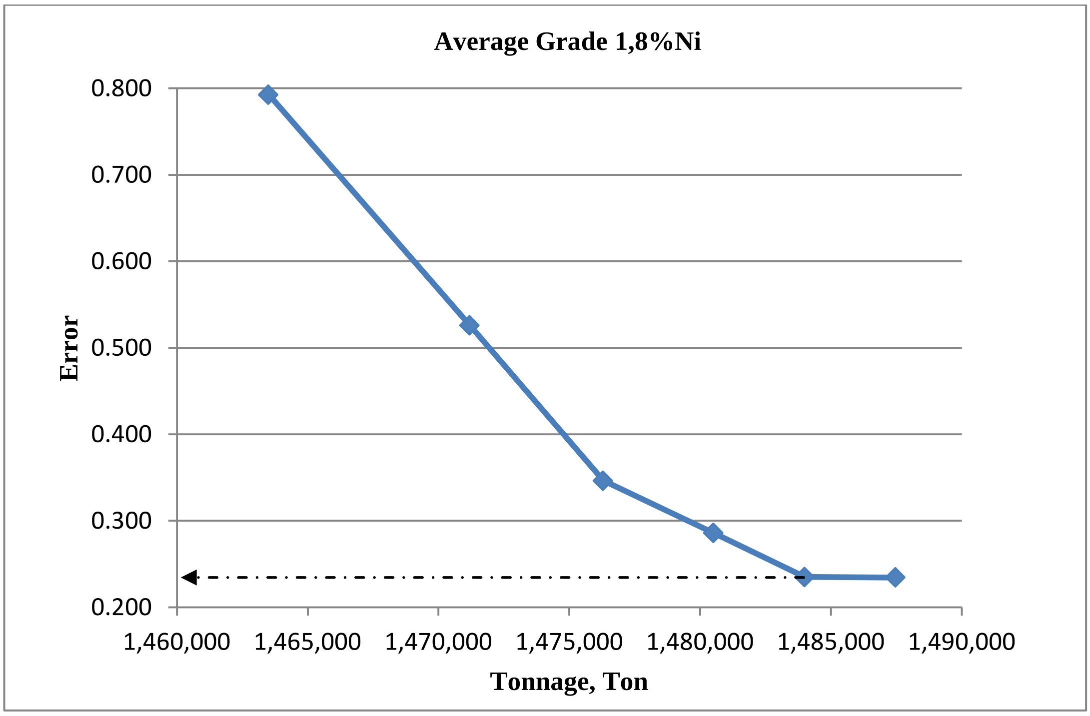

FIGURE 3. VALUE OF ERROR IN AVERAGE GRADE 1,8%Ni

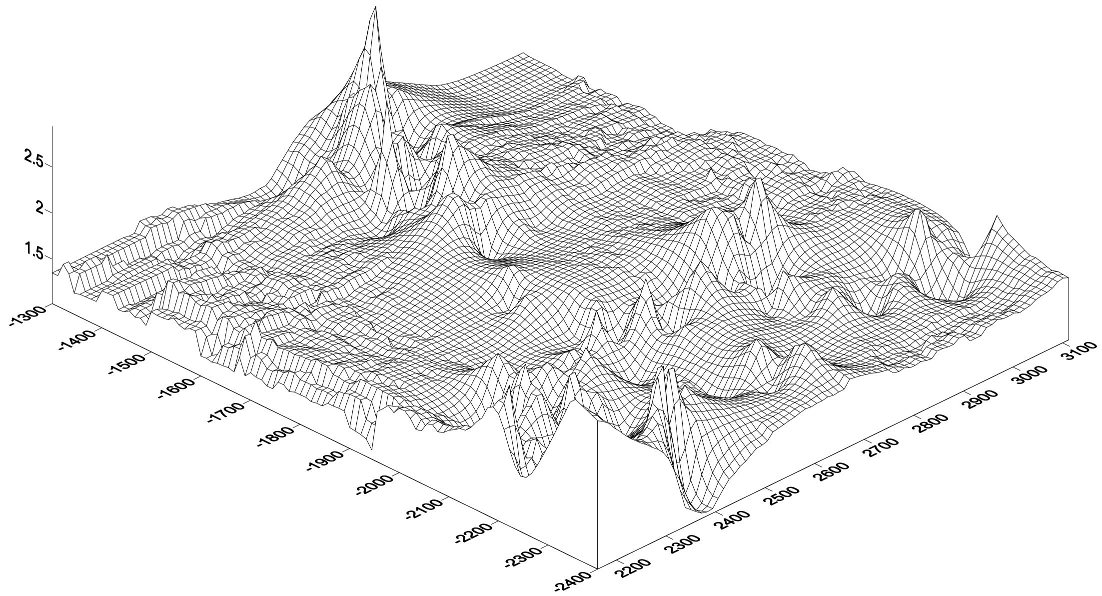

FIGURE 4. BLOCK MODEL OF AVERAGE GRADE 1.6%Ni

IV. DISCUSSION

From Table 5 and Figure 2 , Figure 3 and Figure 4 , shows that for the average grade of 1.6 % Ni which is an average COG obtained tonnage reserves of 2,050,100 tons with an accuracy of $\pm$ 80.7 % in blocks ranging in size less equal to 25 x 25 m . As for the COG average of 1.8 % Ni obtained tonnage reserves of 1,480,520 tons with an accuracy of $\pm$ 76.5 % . in blocks ranging in size from less equal to 25 x 25 m.

Attributed to standardize accuracy values in Table 3 above, the tonnage of the area carefully situations in the category very accurate . If explored more deeply accuracy value is highly influenced by the accuracy of the drill data (exploration and treatment of samples) and the potential resources (clarity limit geological model , cross-section maps , and resource estimation methods)

V. CONCLUSSION

Accuracy lateritic nickel resource tonnage statement is strongly influenced by the accuracy of the data , the geological model , and resource estimation methods . On the resource estimate block method , the estimation accuracy is strongly influenced by the size of the block estimation , accuracy will be obtained in the calculation error (error) which has a constant value (convergent)

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P – 05

Heat Transfer Benchmark Problems Verification of Finite Volume Particle (FVP) Method-based Code

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Abstract—Understanding heat transfer and phase change behavior is one of importance in many field of science and engineering. In order to provide a robust heat transfer simulation code, a heat transfer module has been added to a Finite Volume Particle (FVP) method-based code. This FVP method is a fully lagrangian method developed for incompressible viscous flow, and has been successfully simulate several incompressible flow phenomena. The heat transfer module used equilibrium phase change model to simulate heat transfer and phase change behavior. To verify the heat transfer module's capability, a benchmark calculations was performed. The benchmark problem was a conduction heat transfer involving solidification in an infinite slab. Initial temperatures, material properties and boundary conditions were set, and the benchmark problem was simulated using the phase change model. The calculation results were then compared to the analytical results available beforehand. The calculation results show relatively good agreements with the analytical results. It is confirmed that the model is validated and therefore can be utilize to simulate phase change behavior in incompressible viscous flow with FVP method.

Keywords: *heat transfer, finite volume particle method, benchmark calculation*

I. INTRODUCTION

Heat transfer and phase change phenomena is one of importance in many field of science and engineering. Its application is varied from the solar system, power station generator, climate change, racing car machine, nuclear reactor core accident, etc. There are analytical models to construct the behavior of heat transfer and phase change model. This study is a numerical solution for heat transfer based on those available analytical models. There are several discretization methods to calculate heat transfer problem numerically. Those methods are generally divided into two methods: Eulerian method (mesh method) and Lagrangian method (meshless or particle method). Each method has their own advantage and disadvantage. Eulerian method is cheaper in term of computational resources, but it has limitation in reproducing phase change process qualitatively because it cannot capture the phase change interface accurately. Lagrangian method is able to overcome these problems, but it is more expensive in computational resources. This study used one of the Lagrangian method, called Finite Volume Particle (FVP) method, with a great faith that the computational resources disadvantage will disappear as the technology increase day by day. In order to verify the FVP-based code's ability, a heat transfer benchmark was calculated using equilibrium phase change model. The calculation result shows that the FVP code can reasonably represent the heat transfer benchmark problem with possible improvement in the near future.

II. MATEMATICAL MODELS OF THE FVP METHOD

A. Governing Equation for Heat Transfer and Phase Change

Control equation for heat transfer and phase change model is energy conservation equation. The differential and integral forms of this equation is:

$$\rho C_p \frac{DT}{Dt} = \nabla \cdot (k\nabla T) + Q \qquad (1)$$

$$\frac{D}{Dt}\int_{V} \rho C_p T\, dV = \oint_{S} (k\nabla T)\cdot \vec{n}\, dS + \int_{V} Q\, dV \tag{2}$$

where ρ denotes the fluid density, C_p is the fluid specific heat capacity, T is the fluid temperature, and Q is the fluid heat source.

B. Integral Interpolation of the FVP Method

In the FVP method [1], the fluid is assumed as finite number of fluid particles, which own the physical properties, such as density, temperature and specific heat capacity. Every particle occupies a certain control volume, which is considered as a sphere in 3D system, and a circular in 2D system. The surface *S* and the volume *V* of particle are expressed by (for 2D system)

$$S = 2\pi R \quad, V = 2\pi R^2 = (\Delta l)^2 \tag{3}$$

where *R* is the radius of particle control volume, and Δl is the initial particle distance.

All differential operators in differential govern equations (1), such as gradient and Laplacian terms, are represented by particle interactions on the surface of the particle control volume. According to Gauss's theorem, the gradient and Laplacian operators are expressed by

$$\nabla\phi = \lim_{R\to 0}\frac{1}{V}\oint_{V} \nabla\phi dV = \lim_{R\to 0}\frac{1}{V}\oint_{S} \phi\vec{n}dS \tag{4}$$

$$\nabla^2\phi = \lim_{R\to 0}\frac{1}{V}\oint_{V} \nabla^2\phi dV = \lim_{R\to 0}\frac{1}{V}\oint_{V} \nabla\phi\cdot\vec{n}dS \tag{5}$$

where ϕ denotes the arbitrary scalar function. As a result, in the FVP method the gradient and Laplacian terms of particle *i* can be approximated as

$$\langle\nabla\phi\rangle_i = \langle\frac{1}{V}\oint_{S} \phi\vec{n}dS\rangle_i = \frac{1}{V}\sum_{j\neq i}\phi_{sur}\cdot\vec{n}_{ij}\cdot\Delta S_{ij} \tag{6}$$

$$\langle\nabla^2\phi\rangle_i = \langle\frac{1}{V}\oint_{S} \nabla\phi\cdot\vec{n}dS\rangle_i = \frac{1}{V}\sum_{j\neq i}\left(\frac{\phi_j-\phi_i}{|\vec{r}_{ij}|}\right)\cdot\Delta S_{ij} \tag{7}$$

where ϕ_{sur} denotes the reconstruction values of arbitrary scalar function on the surface of the particle *i*, $\vec{n}_{ij}$ is the unit vector of distance between the particle *i* and *j*, ΔS_{ij} is the interaction surface of particle *i* and *j*, and $\vec{r}_{ij}$ is the vector of distance between the particle *i* and *j*. Since the finite volume particles are assumed to occupy the same volume, the interaction surface ΔS_{ij} of particle *i* with *j* can be calculated by Eq. (8) to ensure that the kernel function form a partition of unity [2]

$$\Delta S_{ij} = \frac{\omega_{ij}}{\sum_{j\neq i}\omega_{ij}}S \tag{8}$$

where ω_{ij} denotes the kernel function between particle *i* and *j*.

The gradients of arbitrary function (such as temperature) are computed on the surface of each particle, and hence the function values for ϕ_{sur} are obtained by using linear reconstruction as

$$\phi_{sur} = \phi_i + \frac{\phi_j-\phi_i}{|\vec{r}_{ij}|}R \tag{9}$$

The kernel function between particle *i* and *j* in the FVP method is defined by

$$\omega_{ij} = \begin{cases}\sin^{-1}\left(\frac{R}{|\vec{r}_{ij}|}\right) - \sin^{-1}\left(\frac{R}{r_e}\right) & |\vec{r}_{ij}|\leq r_e \\ 0 & |\vec{r}_{ij}|\geq r_e\end{cases} \tag{10}$$

where r_e denotes the radius of interaction domain which is called as "the cut-off radius". Figure 1 schematically shows the two-dimensional interactions between finite volume particles.

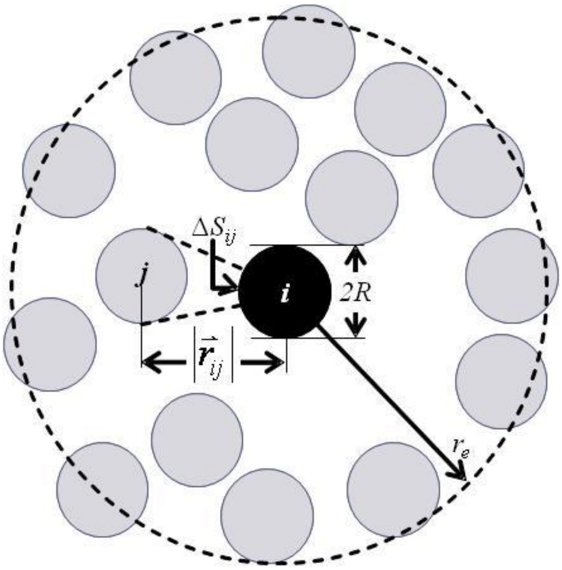


Figure 1. Neighboring particles around particle *i* within the cut-off radius

III. EQUILIBRIUM PHASE CHANGE MODEL

The governing equation that determines the phase change process, Eq. (1), can be expressed as [3]

$$\rho C_p \frac{DT}{Dt} = k\nabla^2 T + Q \tag{11}$$

$$\frac{DT}{Dt} = \frac{k}{\rho C_p}\nabla^2 T + Q \tag{12}$$

here, $Q = 0$, because of no external heat source. The Laplacian term in the above equation is approximated by Eq. (7). Eq. (12) becomes:

$$\frac{T_i^{**} - T_i^{*}}{\Delta t} = \frac{k_{ij}}{\rho C_p}\frac{1}{V}\sum \frac{T_j^{*} - T_i^{*}}{|\vec{r}_{ij}|}\Delta S_{ij} \tag{13}$$

Thermal conductivity coefficient between particle i and particle j, k_{ij}, is defined as

$$k_{ij} = \begin{cases} k_j & \text{if particle } i \text{ is a mixture} \\ k_i & \text{if particle } j \text{ is a mixture} \\ \dfrac{2k_i k_j}{k_i + k_j} & \text{otherwise} \end{cases} \tag{14}$$

Phase change process in this study is treated as equilibrium heat transfer at phases interface. The phase change is determined when the solid particle's temperatures exceed the melting temperature or when the liquid particle's temperatures drop below freezing temperature. The interface temperatures of solid-liquid particles where phase change occurs are the melting/freezing temperature of particle

$$T_i = T_{m/f} \qquad 0 < \alpha_i < 1 \tag{15}$$

The phase change rate to the solid or liquid phase is expressed as the linear change during the freezing/melting process, while the unchanging phase can be recognized as rigid solid or fully liquid.

$$\begin{aligned} \alpha_i &= 0 & H_i &< H_s \\ \alpha_i &= \frac{(H_i - H_s)}{(H_l - H_s)} & H_s &< H_i < H_l \\ \alpha_i &= 1 & H_l &< H_i \end{aligned} \tag{16}$$

where H_i, H_s and H_l is the internal energy of particle *i*, solid and liquid, respectively.

IV. BENCHMARK PROBLEM

This study simulated a benchmark solidification problem of an infinite slab of liquid. This problem has been solved analytically by several authors [4], and simulated by several Euler codes, such as finite element method [5]. The slab was originally one dimension, but in the present study, it is solved as a two dimensional problem with temperature dependent heat capacity and thermal conductivity. The heat capacity of solid and liquid phases is different discontinuously, while the thermal conductivity varies linearly, depend on the solid or liquid fraction of the particle, as defined in Eq. (16). Figure 2 describe the temperature-dependency of heat capacity and thermal conductivity [6].

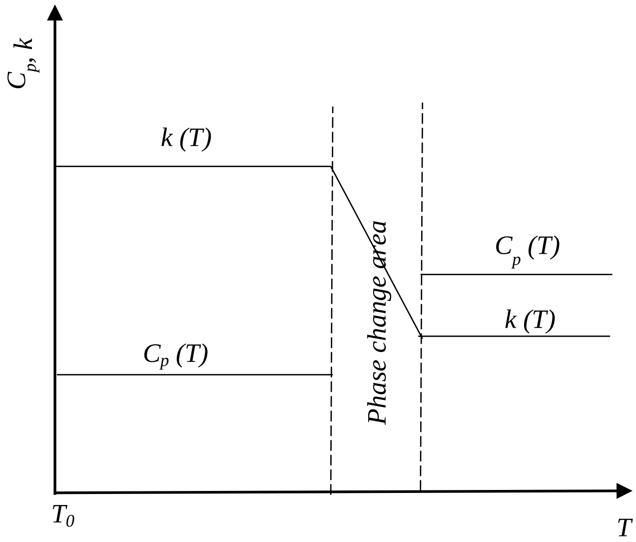


Figure 2. Estimation of thermophysical properties in phase change problems

The slab dimension and the material properties used in the present study is given in Figure 3 and Table 1, respectively. We added one layer in each side of the calculation domain as the boundary wall. These walls were set as non-conductive boundaries. The initial temperature of the most left region (at $x = 0$) was set to 253.15 K while the rest liquid temperature was 283.15 K.

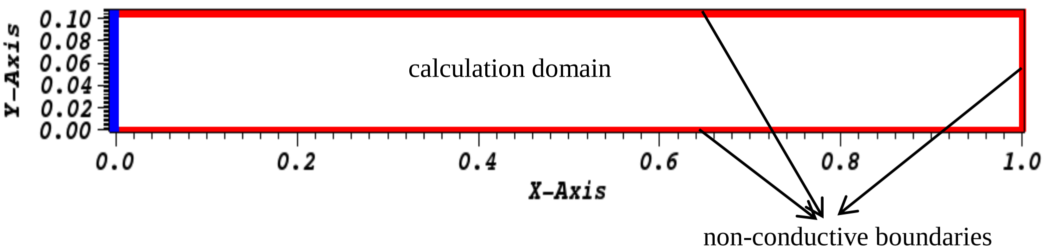


Figure 3. Slab Dimension (in meter)

TABEL 1. MATERIAL PROPERTIES

k	2.22 W/mK (solid)
	0.556 W/mK (liquid)
C_p	1.762×10^6 J/kgK

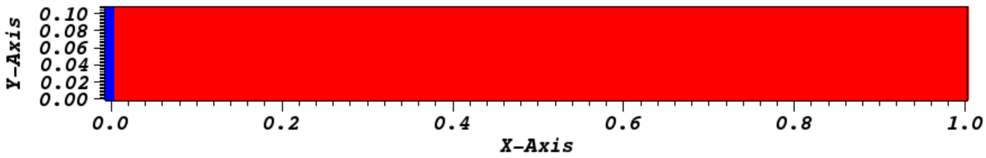
	4.226×10^6 J/kgK
ρ	1 m^3/kg
Freezing temperature	273 K

V. SIMULATION RESULTS

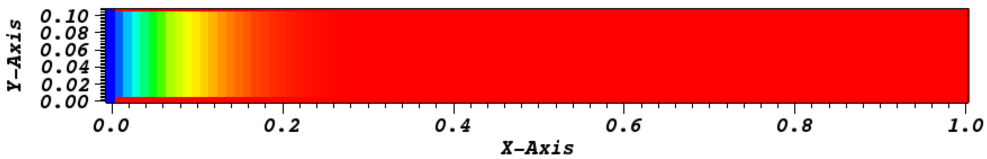
A. Visualization Results of the Heat Transfer Process

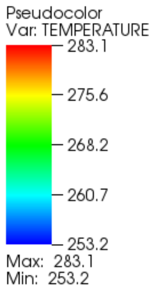
Figure 4 shows the heat transfer process resulted from simulation. At the beginning, at $x = 0$, the temperature was 253.15 K, while the rest was 283.15 K as mentioned above. The temperature difference is described as temperature gradient from cold (colored blue) to hot (colored red). As the time flows, the heat transfer begin from the left side to the right, depicted in the figure as the changing colors. When the liquid's temperature exceeds the freezing temperature, the liquid will become freeze and turned into solid. Due to the relatively small difference of initial temperature (30 K) and low conductivity of the liquid, the freezing process occurred slowly.

t = 0 sec

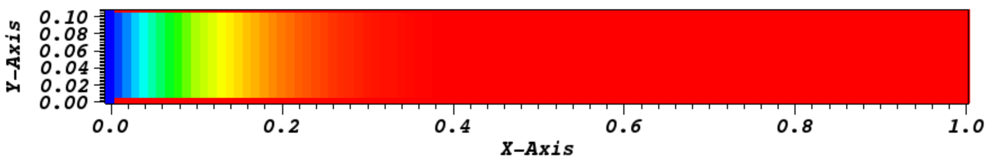


t = 50000 sec





t = 100000 sec



t = 150000 sec

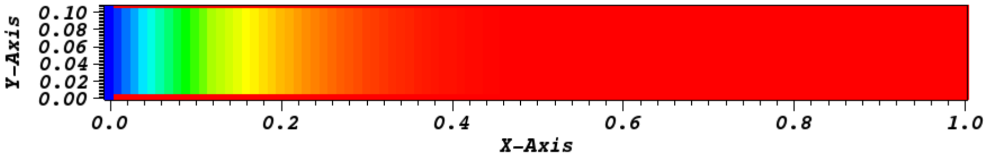


Figure 4. Heat Transfer Process in Simulation

B. Temperature Distribution

The simulation results were also compared quantitatively with the analytical solution provided by Luikov. The temperature distribution along the slab were compared at 18000 sec, 72000 sec and 144000 sec as can be seen in Figure 5, 6 and 7 below.

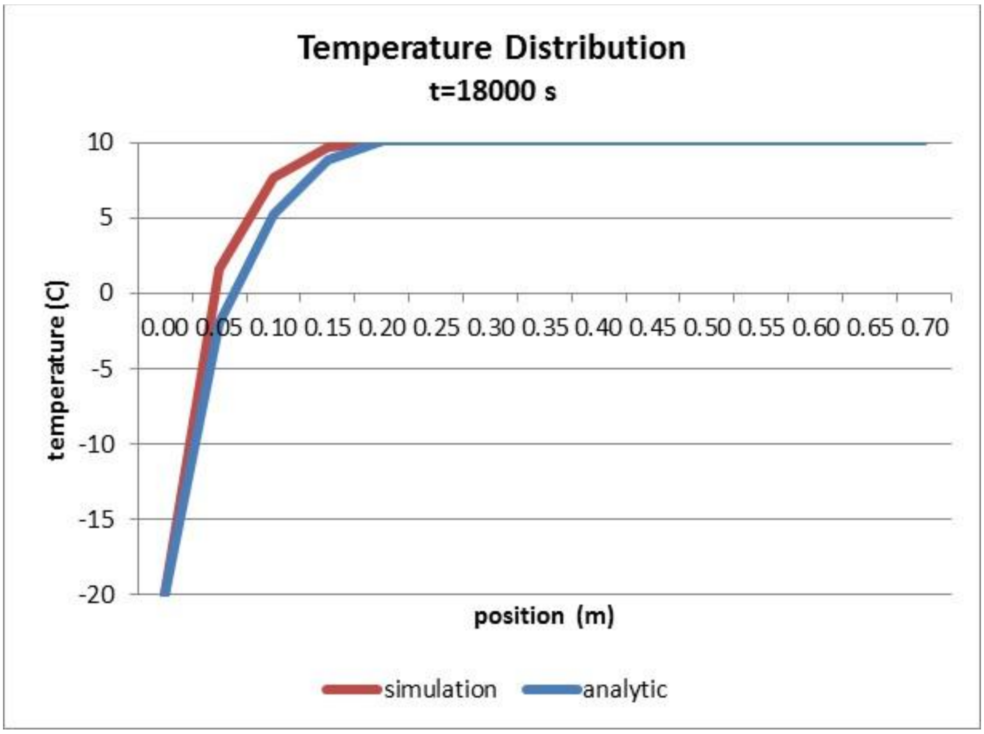


Figure 5. Temperature distribution at t = 18000 sec

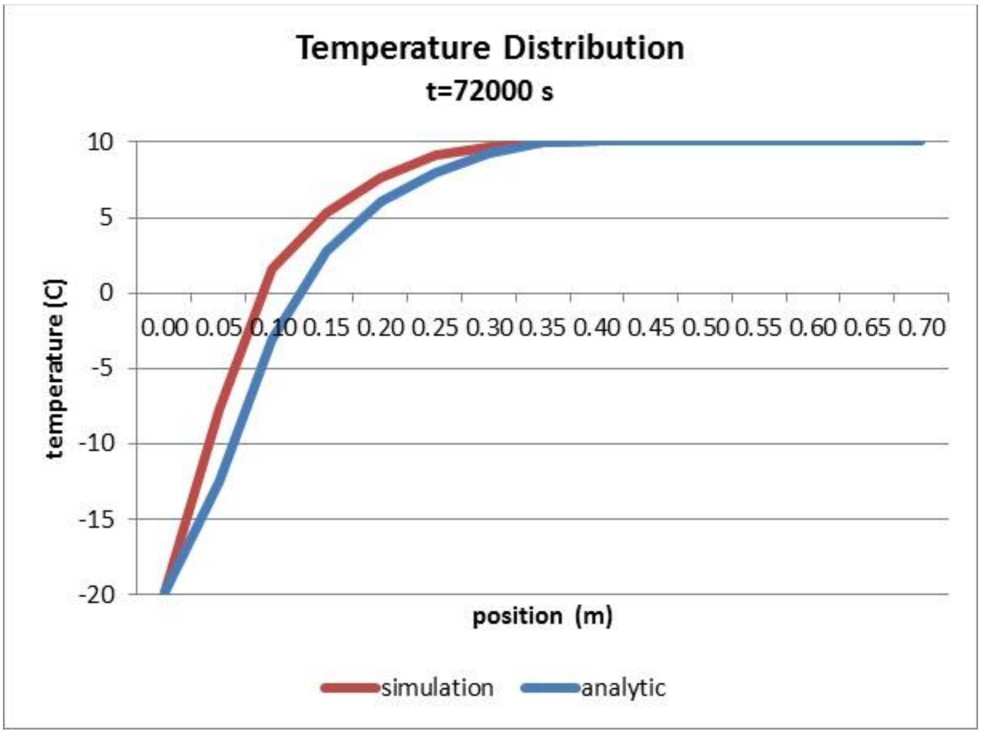


Figure 6. Temperature distribution at t = 72000 sec

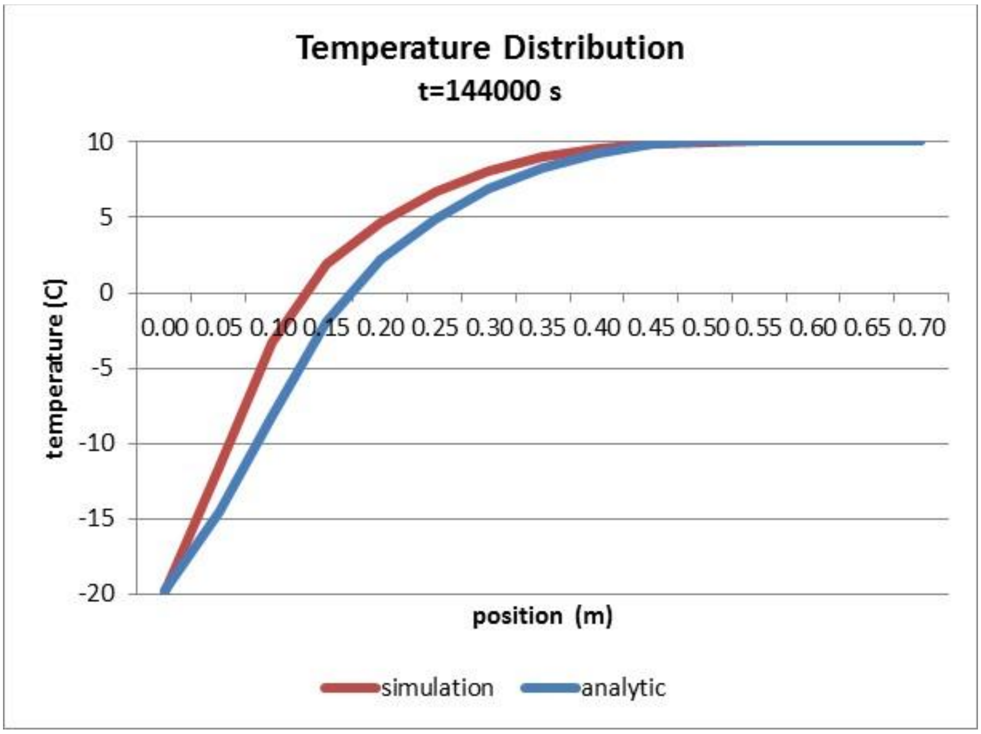


Figure 7. Temperature distribution at t = 144000 sec

The graph shows that at the initial slab position, the simulation results always over-estimate the analytical results. The maximum relative error was 2.01%. However, the position where the slab temperature is still unchanged for every time step are relatively same for both simulation and analytical results. The difference between simulation and analytical results are estimated as the result of the discretization size and time step. In this simulation, we used $\Delta l = 0.01$ m as the initial particle distance and $\Delta t = 0.01$ sec. We used these numbers in order to minimize the computational load, due to our lack of computational resources. It is strongly believed that the simulation results will have better agreement if we use smaller initial particle distance and smaller time step (standard FVP calculation uses $\Delta t = 10^{-4}$ sec). In the near future, we are planning to simulate this benchmark problem with another phase change model, i.e. non-equilibrium phase change model to investigate the model's effect on the simulation results.

VI. CONCLUDING REMARKS

In this study, a benchmark problem involved conductive heat transfer and phase change has been conducted. The simulation used FVP method and equilibrium phase change model to discretized calculation domain and to simulate the heat and phase change behavior. The benchmark problem used in this study was a solidification in an infinite slab, which was described as two dimensional problems. The simulation and analytical results were compared and showed relatively good agreement with each other. The maximum relative error was 2.01%, and further investigation will be conducted to improve the present simulation results.

ACKNOWLEDGMENT

The present study was carried out with the code developed at Morita Laboratory, Kyushu University, during the doctoral study of the author. The computation was mainly carried out using the computer facilities at Computer Laboratory Department of Physics Education, Universitas Negeri Yogyakarta.

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P - 06

Radioactive Elements in Consumer Products

Study Case: Menthol Gasoline

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***Abstract*—** Humans are exposed to both natural and man-made radiation through consumer products, food, drinking-water and beverages. One type of consumer products that contain radioactive elements are Menthol Gasoline. Therefore, research on consumer products is done to ensure the safety levels of use. The purpose of this study was to determine the radioactive elements contained in Gasoline Menthol and its specific activity and determine the exposure dose on the sample. The determination of the specific activity of samples was done by using gamma ray spectrometry, determination of exposure dose while using Survey Meter. Results of the study found that in Gasoline Menthol contained some radioactive elements, namely Th-232, U-238 and K-40. The specific activity of radioactive elements in the Menthol Gasoline is 496.66 ± 146.94 Bq/g for an element of Th-232, 8.35 ± 6.78 Bq/g for an element of U-238, and 28.88 ± 9:52 Bq/g for an element of K-40. Exposure dose on the sample surface Menthol Gasoline was found at 18.29 μSv/h. Therefore, radiological effect may be felt by the consumers since the menthol gasoline sampels showed beyond safety threshold levels, which included the U-238 and Th-232 specific activity of 1 Bq/g and annual dose of 1 mSv/yr (0.5 μSv/h).

Keywords: *Radioactive Elements, Consumer Products, Menthol Gasoline*

I. INTRODUCTION

With the development of technology, the use of radioactive material in consumer products increases, some of these products directly utilize the properties of ionizing radiation from radionuclides used as Am-241 in a smoke detector smoke detector ionization chamber (ICSD), and there is also a chemical or physical of the material radionuclides used for example for bulbs gasoline by combining thorium compounds [6].The release of radioactive material has potential as a source of human exposure to radiation. Aside from external exposure, internal exposure could occur also like to drink, inhale, inject or absorb radioactive substances [4].

Most of the radiation dose received by the general public and radiation workers (regular or accident) is commonly referred to low doses. The meaning here is that it is low at a low dose, eg 10 mSv per year. As reported that the average radiation dose received by the population in the US is a low dose. It is important to know the effects of low doses of radiation, or more precisely the effect of small doses of natural background that cannot be avoided. However, this effect is less known [11].

The effects of radiation on humans occur because the energy put in body tissues, which can cause tissue damage or death. In some cases these effects may not be significant. However, in some cases, cells can survive but become abnormal, either temporarily or permanently. In addition, abnormal cells can become malignant. In the event of damage to the genetic material (DNA) contained in the cells of the body will cause cancer when DNA damage in reproductive cells will cause mutations that can be inherited by future generations. There are two types of exposure that chronic exposure (continued on radiation dose is low and a long period, for example cancers and cataracts) and acute exposure (dose of radiation is high and the short period of time eg blood changes and syndrome of the central nervous system) [4] [11].

Consumer products are manufactured product or appliance, or a variety of sources, in which the radioactive material is intentionally or unintentionally entered and can be supplied to the public without special surveillance and control [12].Consumer products are divided into five categories according to the

UNSCEAR 1982 [10] radioluminous products; electronic and electrical equipment; anti-static devices; smoke detectors; ceramics, glassware, and other alloys containing uranium or thorium. Radiation generated by consumer products either contain radionuclides of artificial or natural radionuclides substance intentionally added so much to the radioactivity accidentally activated.

Gasoline menthol often used in gas lanterns camp. The incandescent bulb was discovered by Austrian chemist Carl Auer von Welsbach in 1885. He combines a host of cotton with some salt causes incandescence when the bulb is placed inside the lanterns and heated by a gas flame. He improved the composition of the salt content in the following years([1][2][3])and found a mixture of 99% and 1% CeO2 ThO2 most promising and give light and fire. Effects of compounds have been added to improve the mechanical stability of the bulb. Basically, these compositions have been used to date. Because Th is a radioactive heavy metal, mixed-use alternative (non-radioactive) are becoming more popular[5][12].

Containing incandescence menthol will produce thorium when menthol is heated by fire. Uranium nitrate mixed into networking Fabril during manufacture of the bulb. When placed in light and burned, thorium nitrate turns into thorium oxide, which then produces incandescence. Although the use of thorium initially only on the bulb, the presence of thorium and its descendants increased over time and can be present in large quantities. Potential routes of exposure from this bulb bulbs external exposure during handling; internal exposure due to inhalation and ingestion of radionuclides waste incineration and disposal; internal exposure due to abuse and thoron emanation of gas menthol [12].

II. Methods

A. Determining the Dose Exposure

Dose limit for the general public in Indonesia is 0.5 mSv / year or 0.01 mSv/week or 0.25 μSv/h (Radiation Safety Regulations are governed by The Decree Of Head Nuclear Energy Regulatory Agency No. 01/KaBAPETEN/V-99). Regulation is intended as a radiation safety requirements for those working with sources of ionizing radiation in the field of health, industry, education, research and others. That provision is a minimum requirement that must be met [9].

In determining the exposure dose to sample consumer products, tools to be used is portable survey meter. Readings will be taken on the sample surface, at a distance of 30 cm and at a distance of 1 meter.

B. Determining Specific Activity Radionuclide

After the exposure dose released by the sample, the next step is to determine the specific activity of radionuclides contained in the sample. Where each peak detected energy is determined by reference to the type of radionuclide radionuclide IAEA-TECDOC_564 table.

Gamma-ray spectrometry is used to determine the type of radionuclides in samples of consumer products. Which samples will be weighed and placed into containers and practically for 12 hours (Poljanc et al, 2007).

Determination of radionuclides is performed using efficiency curves. In which case it requires a graph of efficiency (%) versus energy (keV) for all the standard elements contained in the Certificate Standards (Multinuclide) 1280-56. The standard activity for each radionuclide is determined using the following equation,

$$A = A_0\, e^{-\lambda t} \tag{1}$$

Where
A = The final activity standards (Bq)
A_0= The standard initial activity (Bq)
t = period of time (days or years)= ln 2/$t_{1/2}$
$t_{1/2}$= half-life (days or years)

To determine the radioactivity of these elements, the equation is

$$As = \frac{CPS}{E x \gamma x M} \tag{2}$$

Where
As = The specific activity of the sample (Bq/g)
M = mass of the sample (g)
E = the efficiency

γ = abundance of gamma

C. Determining the Dose Rate of Gamma Rays

With the radioactivity of the elements found in all of the gamma dose rate can be calculated using the following formula;

$$D_{30cm} = (1.6 \text{ x } A \text{ x } E)\ \mu Sv/h \tag{3}$$

Where,
A = activity in MBq
E= total energy gamma (MeV) per decay.

As for determining the dose rate at a distance of 1 m is determined using the following formula

$$D_{1m} = 0.55CE \text{ rad/h} \tag{4}$$

Where ,
C= activity in Curie
E = photon energy in MeV

III. RESULTS AND DISCUSSION

A. Dose Exposure Analysis

The exposure dose for all types of samples was conducted using a survey meter. The reading is given as Table 1 Which of the results obtained show that the reading given by menthol gasoline is 18.92 μSv / h, which means that more than the prescribed dose limit for the public of 1 mSv / year (0.5 μSv / h).

From the analysis obtained show that the consumer should be given attention by the authorities, whether licensed or even prohibited its use because it has exceeded the radiation dose that has been set for the public of 1 mSv/year (0.01 mSv/week or 0.25 μSv/h (Radiation Safety Regulations are governed by The Decree Of Head Nuclear Energy Regulatory Agency No. 01/KaBAPETEN/V-99). [9]

Tabel 1 Sampled exposure dose at the surface and a distance of 1 meter from the sample

Sampel	**Dos (μSv/h)**		
	Surface	**Distance of 30 cm**	**Distance of 1 meter**
Gasoline menthol	18.92	0.67	0.00

B. Analysis of Specific Radioactivity In Samples

Based on the analysis conducted on a sample of gasoline menthol available which generally result there are many radionuclides that have been detected, but from all the radionuclides are detected decay series of U-238, Th-232 and K-40.

As for the distribution of the specific activities of radionuclides in the sample menthol gasoline shown in Figure 1 From the figure we can see that the distribution is shown by radionuclides from the decay series Th-232 of Ac-228 (338.32 keV, 11.25%) with a value of 496.66 ± 146.94 Bq / g, Ac-228 (463.71 keV, 4:44%) with value of 449.74 ± 132.79 Bq / g, Ac-228 (911.21 keV, 26.6%) with a value of 433.18 ± 127.79 Bq / g, Ac-228 (794.95 keV, 4.34%) with a value of 415.36 ± 121.89 Bq / g, Ac-228 (968.97 keV, 16:17%) with a value of 393.14 ± 117.01 Bq / g, Ac-228 (964.77 keV, 11.5%) with a value of 321.73 ± 92.97 Bq / g, Pb-212 (238.63 keV, 53.65%) with a value of 264.25 ± 96.72 Bq / g, Bi-212 (727.25 keV, 11.80%) with a value of 218.07 ± 67.98 Bq / g, Tl-208 (860.56 keV, 12.42%) with a value of 148.62 ± 18:20 Bq / g, Tl-208 (583.19 keV, 84.48) with the value of 143.70 ± 14.71 Bq / g, Tl-208 (510.77 keV, 22.61%) with a value of 123.64 ± 39.19 Bq / g and Tl-208 (2614.53 keV, 99.16%) with a value of 101.72 ± 32.44 Bq / g.

The K-40 radionuclides (1460.83 keV, 10.67%) with a value of 28.88 ± 9:52 Bq / g. For the decay series of U-238 is Ra-226 (186.1 keV, 3.50%) with a value of 8:35 ± 6.78 Bq / g, Bi-214 (1120.27 keV, 15.00%) with a value of 3.70 ± 0.85 Bq / g and there is also a Cs-137 (661.66 keV, 85.21%) with a value of 0:41 ± 0.03 Bq / g.

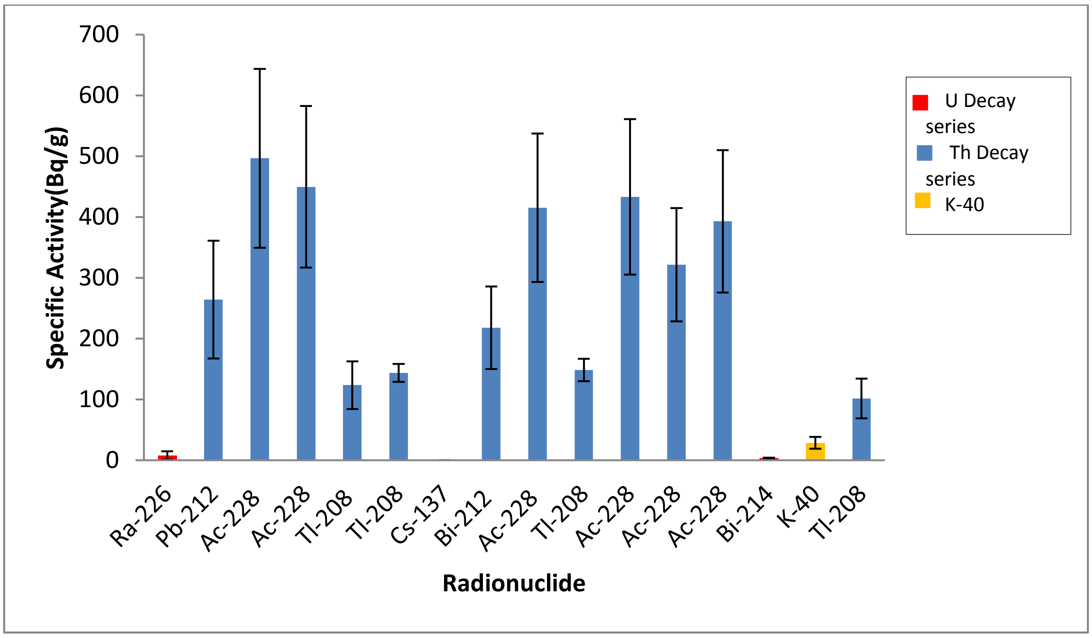

Figure 1. The specific activity of radionuclides in the sample menthol gasoline

The reading obtained is in excess of the limit set by the IAEA (2006), namely the U-238 (1 Bq / g), Th-232 (1 Bq / g) and K-40 (10 Bq / g). [8]

C. *Gamma Ray Dose Rate Calculations*

To find the specific activities of all radionuclides the gamma dose rate shall be calculated either on a distance of 30 cm even at a distance of 1 m. Results are available for the calculation of dose rate of gamma rays at the sample when compared with the reading on the meter dose as shown in Table 2. The review found that the reading on the meter review is higher when compared with the reading of the dose obtained by calculations. This is caused, in this study used survey meter that can detect gamma rays and x-rays while reading using the calculation only takes into account the radionuclides that emit gamma rays only.

Tabel 2. Comparative readings dose using survey meter using calculations

Sampel	Reading dose using survey meter			The dose rate of gamma rays through calculation	
	Surface (μSv/h)	Distance of 30 cm (μSv/h)	Distance of 1 m (μSv/h)	Distance of 30 cm (μSv/h)	Distance of 1 m (μSv/h)
Gasoline menthol	18.29	0.67	0.00	$1.55x10^{-2}$	$1.44\ x10^{-15}$

Acknowledgment

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P – 07

RELATIVISTIC DEUTERON IN ONE-PION EXCHANGE

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Abstract**—** This paper presents theoretical review of interaction in a two nucleon system in the form of proton and neutron bounded by specific potential producing bounded state which is known as deuteron. Wave function being used is relativistic wave function. As the result of proton-neutron interaction, deuteron has a mixed state, i.e. the angular momentum L at $L = 0$ and $L = 2$ are associated with wave function of $u(r)$ and $w(r)$.

From the calculation, in short distance ($r_c = 0{,}4$ fm) there is an infinite potential wall, thus there is no deuteron exist in the interval of $(0 \le r \le r_c)$ fm. In medium distance $(1 \le r \le 2)$ fm, there is a scalar meson $(\pi, \rho, \omega, \sigma)$ exchange, and in long distance $(r > 2$ fm$)$ there is a single pion exchange. The calculated deuteron binding energy is –2,2427356 MeV.

Keywords: *binding energy, deuteron, relativistic wave function*

I. INTRODUCTION

Nucleon-nucleon interaction produces force between them. Inside an atom, electrons are bounded by a central electrostatic potential produced by protons in the nucleus and between the electrons. It means, the force exerted to an electron comes from two sources, from the nucleus and from interaction with another electron. Inside the nucleus, there is no external source producing force exerted to single nucleon as an interaction with single particle. Single particle operator in the nucleus Hamiltonian only takes the form of kinetic energy associated with nucleon motion as an "effective" single particle interaction in nuclear interaction potential and can be obtained from the average of interaction between pair of nucleons inside the nucleus.

II. DEUTERON MIXED STATE

The Schrödinger equation in the center of mass coordinate system:

$$-\frac{\hbar^2}{2m^*}\frac{d^2\psi(r)}{dr^2} + V(r)\psi(r) = E\psi(r) \qquad (1)$$

where m^* is the reduced mass between proton and neutron mass; interaction potential V and wave function ψ are the function of r, θ, ϕ, spin $\vec{\sigma}_1$, $\vec{\sigma}_2$, and isospin $\vec{\tau}_1$ and $\vec{\tau}_2$, and, E is energy. Proton-neutron interaction potential in equation (1) can be rewritten into potential form containing central force $V_C(r)$ and tensor force $V_T(r)$,

$$V(r) = V_C(r) + V_T(r)\hat{S}_{12} + V_{LS}\vec{L}\cdot\vec{S} \qquad (2)$$

where $\hat{S}_{12}$ is the tensor operator and $\vec{L}\cdot\vec{S}$ is the spin-orbit [1], [2]

$$S_{12} = \frac{3}{r^2}(\vec{\sigma}_1.\vec{r})(\vec{\sigma}_2.\vec{r}) - \vec{\sigma}_1.\vec{\sigma}_2 \qquad (3)$$

Deuteron has even parity, hence it cannot have an odd-value of L $(L = 1)$, and can only have an even-value of L, i.e. $L = 0$ (S-state) and $L = 2$ (D-state). Experimentally, spin value for deuteron in ground state is 1, i.e. proton and neutron spins are parallel (↑↑). To be coupled, the acceptable value of $[L, S]$ is $[0{,}1]$ and $[2{,}1]$. The contribution for total angular momentum of deuteron $J = 1$ from $(L = 0)$ state is more dominant than $L = 2$ state. In standard form, deuteron spin and parity can be stated as $J^\pi = 1^+$ [3]. In addition, anti-symmetric two nucleon isospin condition gives ground state deuteron $T = 0$. In spectroscopic notation, $L = 0$, and $S = 1$ state is stated as ${}^3S_1$ (triplet S-state) and $L = 2$, and $S = 1$ as ${}^3D_1$ (triplet D-state) [4], [5], [6], [7], [8], [9].

To get the coupled radial equation in the Schrödinger equation,

$$\frac{1}{r}\left[\left(\frac{d^2}{dr^2}-\frac{L^2}{r^2}\right)-\upsilon+k^2\right]$$
$$\times\left(u|L=J-1,S=1,JM,TM_T\rangle+w|L=J+1,S=1,JM,TM_T\rangle\right)=0 \quad (4)$$

where L^2 operate in angular momentum eigenfunction, to get the precise value $L(L+1)$. Multiply this equation from left, first by $\langle L=J-1,S=1,JM,TM_T|$ and second by $\langle L=J+1,S=1,JM,TM_T|$ and use the orthonormalization of this equation to get the simpler form gives two coupled radial equations

$$\left[\frac{d^2}{dr^2}-\frac{J(J+1)}{r^2}+k^2\right]u-\langle J-1,S=1,JM,TM_T|\upsilon|J-1,S=1,JM,TM_T\rangle u-$$
$$\langle J-1,S=1,JM,TM_T|\upsilon|J+1,S=1,JM,TM_T\rangle w=0 \quad (5a)$$
$$\left[\frac{d^2}{dr^2}-\frac{(J+1)(J+2)}{r^2}+k^2\right]w-\langle J+1,S=1,JM,TM_T|\upsilon|J+1,S=1,JM,TM_T\rangle w-$$
$$\langle J+1,S=1,JM,TM_T|\upsilon|J-1,S=1,JM,TM_T\rangle u=0 \quad (5b)$$

Matrix elements υ are the same for non-diagonal of L since $\hat{V}$ is hermitian. Radial function from non-diagonal matrix elements υ are stated as $\mathcal{H}(r)$. The same function from non-diagonal matrix elements υ of $L = J - 1$ and $L = J + 1$ state are stated as $\mathcal{F}(r)$ and $\mathcal{G}(r)$. Coupled radial equation can be written as

$$\frac{d^2u}{dr^2}-\frac{J(J-1)}{r^2}u+k^2u+\mathcal{F}(r)u+\mathcal{G}(r)w=0 \quad (6a)$$

and

$$\frac{d^2w}{dr^2}-\frac{(J+1)(J+2)}{r^2}w+k^2w+\mathcal{G}(r)w+\mathcal{H}(r)u=0 \quad (6b)$$

A solution of $\binom{u}{w}$ from equation (6) can be multiplied by an arbitrary number, and $\binom{u}{w}$ is the solution for homogeneous equation. The potential, u and w are obtained at $r=r_c$ toward $r\to\infty$ [10].

The ground state of deuteron is a unique problem, that is its coupling, equation (6), with $k^2=-\gamma^2$ (bound state) and $J=1$. Wave function u and w each represents the radial function of $^3S_1$ dan $^3D_1$ state. The centrifugal form, $J(J-1)$ becomes zero in equation (6a). For $r\to\infty$, the asymptotic form u/r and w/r with $L=0$ and $L=2$, gives

$$u(r)=\mu r h_0^{(1)}(i\mu r)=\mu r[j_0(i\mu r)+in_0(i\mu r)]=e^{-\mu r};\quad \text{for } r\to\infty \quad (7a)$$
$$w(r)=\mu r h_2^{(1)}(i\mu r)=e^{-\mu r}\left[1+\frac{3}{\mu r}+\frac{3}{(\mu r)^2}\right];\quad \text{for } r\to\infty \quad (7b)$$

The coupled equation can be written in a simpler form,

$$\frac{d^2u}{dr^2}=\bar{f}u+\bar{h}w \quad (8a)$$
$$\frac{d^2w}{dr^2}=\bar{h}u+\bar{g}w \quad (8b)$$

where $\bar{f}$, $\bar{g}$ and $\bar{h}$ as function of r, with normalization condition [9], [11],

$$\int_0^\infty[u^2(r)+w^2(r)]dr=1 \quad (9)$$

III. RESULTS AND DISCUSSION

Using computer, the mathematical equations in the form of two coupled Schrödinger equations in independent variable of r (distance between proton and neutron) can be solved, producing coupled state wave function and binding energy for deuteron.

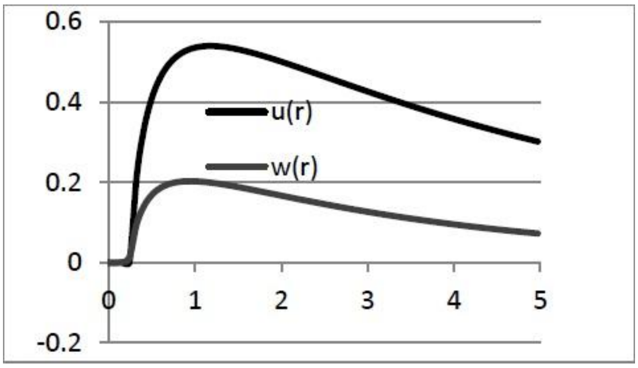

Figure 1. Deuteron Wave Function

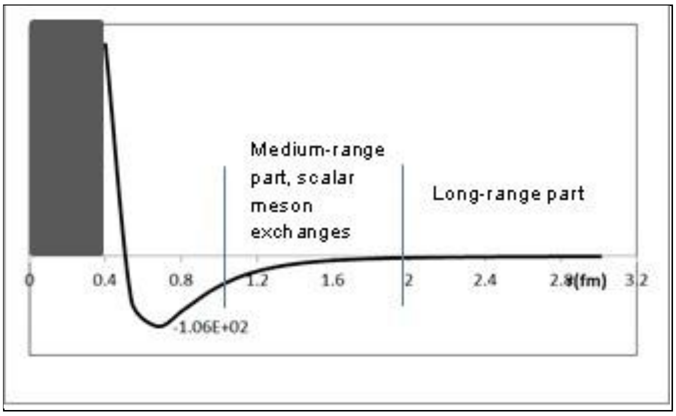

Figure 2. Proton and Neutron Interaction Potential

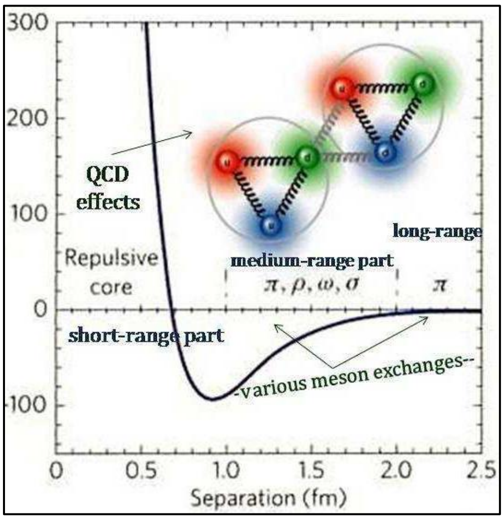

Figure 3. Nucleon-Nucleon Potential [10]

From computation, it is known that there is a repulsive force starting from $r_c = 0{,}4$ fm, meaning that $0 \leq r \leq r_c$ region is an infinite height potential wall, thus the probability to find particles (deuteron) in this interval is zero (see figure 2).

For far enough distance, $r \to \infty$, there is an attractive force so that both particles move closer. The main part of the attractive force is located around radius of $1 \sim 2$ fm, where the scalar meson $(\pi, \rho, \omega, \sigma)$ exchange takes place, and $r > 2$ fm for the pion exchange (see figure 2 and 3).

The calculated binding energy for deuteron is –2,2427356 MeV, which is in a close range with experimental result.

IV. CONCLUSION

The computation gives mixed state wave function $u(r)$ and $w(r)$ for deuteron, where the $u(r)$ associated with $L = 0$ state is more dominant than $w(r)$ associated with $L = 2$ state, that is the $L = 0$ state is around 96% and the $L = 2$ state is around 4%. From interaction potential, there is repulsive force start from distance of $r_c = 0{,}4$ fm, meaning that $0 \leq r \leq r_c$ region is an infinite height potential wall, thus the probability to find particles (deuteron) in this interval is zero. For middle distance $(1 \leq r \leq 2)$ fm, there is scalar meson $(\pi, \rho, \omega, \sigma)$ exchange, and for far distance $(r > 2$ fm$)$ there is single pion exchange. The binding energy for deuteron is –2,2427356 MeV.

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PE – 01

Quantitative Comparison of The Effect Factors in Electromagnetic Induction Using Audacity Freeware

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Abstract **-** This article describes the development of inexpensive experimental kit and utilizing a freeware as a tool to study the effect factors in electromagnetic induction. We used a small cylindrical magnet and different set number of turns, diameter and velocity of a moving magnet in making a comparison. A computer is able to detect changes in signal via external media. An experimental set-up is connected to an external media to detect and measure the changes of EMF amplitudes signal. The signal is processed, analyzed and displayed on Audacity screen to compare. Every result is arranged on the same graph and scale to make the comparison. The finding shows that, through Audacity we can explain the effect factors in electromagnetic induction experiments. In addition, the development of low cost kit and used together with Audacity can assists students in understanding the concept and experiment of electromagnetic induction topic.

Keywords: *Audacity, Experimental kit, Electromagnetic induction, Freeware*

I. INTRODUCTION

Nowadays, computer is a technology integrated in human daily life. Almost all human activities use a computer. Besides the well-known negative effect of these instruments, researchers have turned to a useful tool in physics education [1]. Through this technology, it can nurture and foster interest and positive attitude towards teaching and learning of Physics. Many studies clearly identified the students faced difficulties in understanding electromagnetic induction especially in facing the role of magnetic field flux and of its time variation [2, 3]. Then, the traditional teaching method such as chalk and talk is one of the factors encouraging students think negative about physics [4]. Many researchers agree that the ways of learning are not able to develop student's science knowledge. Furthermore, students carried out about 25% of physics hands-on experimental activities in school's laboratories [5]. Most teachers do not carry out experiment because lack of time, kits, equipment, teachers' skill and so on. Experimental activities are curial parts in Physics. Through the hands on and minds on activities, it can boost the science process skill and higher order thinking skill [6]. To overcome those problems, the researchers propose the utilizing of computer as a tool for performing physics experiments. The usage of cheap and easy acquisition systems can capture students' attention; allowing them to appreciate the role of physics in their daily lives [7]. An on-line experiment in which real-time graphs allow experimenter to face the conceptual nodes relative to induced currents in electromagnetic phenomena. In this article, we present an overview about the development of an experimental kit and utilizing a freeware to study the relationship of number of the turns, diameter of coil and relative motion between the magnet and coil as effect factors in electromagnetic induction.

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II. Methodology

A. *Experimental Set up*

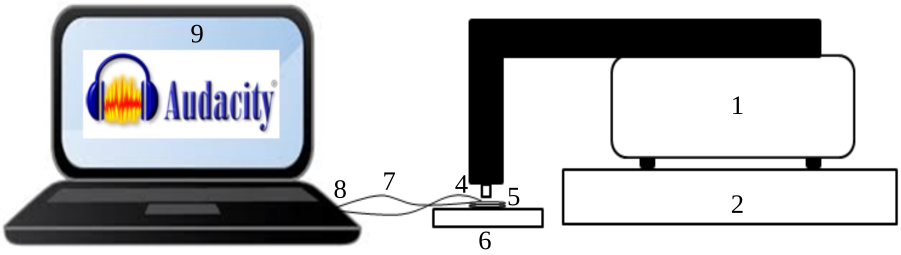
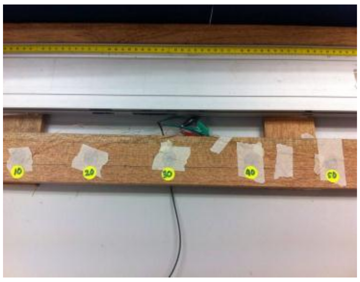


FIGURE 1. EXPERIMENTAL SET UP (FRONT VIEW). 1: TROLLEY; 2: TRACK; 3; MAGNET HOLDER; 4: CYLINDRICAL SHAPE MAGNET; 5: COIL 6: COIL HOLDER; 7: AV CABLE; 8: MICROPHONE JACK 9; LAPTOP/PC

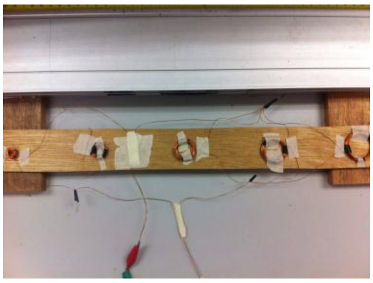
We proposed a simple set up experimental set as shown in fig. 1. A cylindrical magnet (diameter 1.0 cm and height 1.5 cm) is used together with trolley and track (friction is negligible) to make sure the magnet is moved at a constant velocity. Then, we constructed coils from the same material and diameter of copper wire. The coil is placed underneath the magnetic bar to produces induced EMF when the magnet passes through it. The coils connected through a microphone jack of a computer by using audio cable to detect the signal.

B. *Different Set of Number of Turns (N), Diameters Area of Coil (d)* and *Velocity of Magnet (v)*

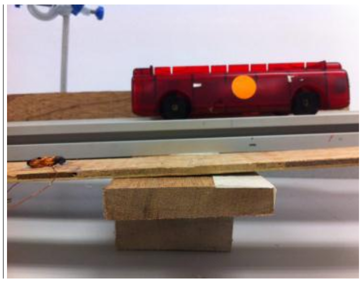
To observe the effect of number of turns on the induced EMF, we designed five (5) coils with number of turns, N = 10, 20, 30, 40 and 50, diameter, d is 1.5 cm and the velocity, v is 0.2 ms^{-1} and all coils placed on the platform as shown in fig. 4(A). The second experiment is to see the effect of different diameter on the induced EMF, five (5) coils with diameter, d = 1.0, 1.5, 2.0, 2.5, and 3.0 cm, are fabricated and placed on the same axis as shown in fig. 4(B). The last experiment is to observe the effect of speed of the moving magnet on the induced EMF in 40 turns and 1.5 cm diameter coil. The speed of the moving magnet is measured using an open source known as Tracker while the speed is varied by adjusting the elevation angle of the track. The experimental set-up shown in fig. 4(C).



(A) *d = 15 mm and v = 0.2 ms^{-1}*



(B) *N = 40 and v = 0.2 ms^{-1}*



(C) *N = 40 and d = 15 mm*

FIGURE 4. EXPERIMENT SET (A) DIFFERENT NUMBER OF TURNS; (B) DIFFERENT DIAMETER; (C) DIFFERENT VELOCITY

C. *Data Measurement*

A computer can detect the changes of signal amplitude and shape via internal or external microphones of a sound card. In this experimental set up, a computer detects the induced EMF through a microphone jack that is connected to a microphone port. When the magnet reached the edge of the coil, an induced current start to flow in the coil and due to the resistance of the coil will produce EMF that can be detected by the sound card. The Audacity is used to detect, record, process and display the EMF signal in arbitrary unit on the computer screen.

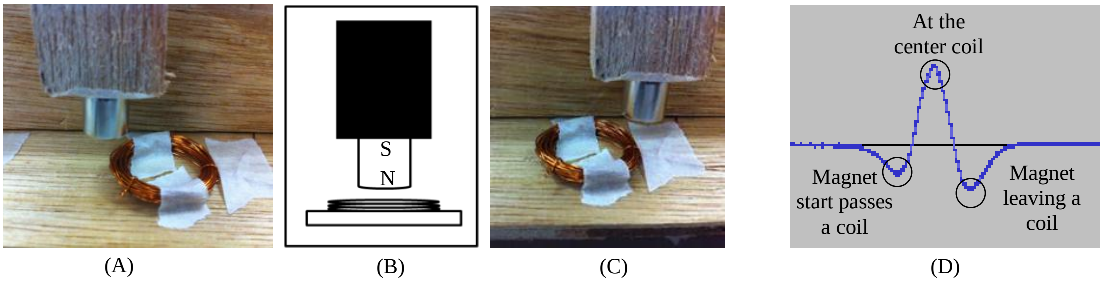


FIGURE 5. THE MAGNET (A) START CROSSING, (B) AT THE CENTER (C) LEAVING. THE PICTURE (D) SHOW THE INDUCED EMF

Fig. 5 (A to C) shows the position of the magnet and the coil, while Fig. 5 (D) shows the detected induced EMF amplitude signal when the magnet reached at the edge, at the center and the opposite edge of the coil. As the magnet approaches the coil, the induced current flow in anticlockwise direction and the same phenomenon occurs at the other edge of the coil. When the magnet moving across the coil the induced current flow in a clockwise direction. These shape of electrical signal acquired because the North Pole of the magnet is facing toward into the coil. If we change the polarity of the magnet or connection of the wire, the opposite shape of the electrical signal is produced.

III. DATA ANALYSIS

The Audacity allows us to perform the analysis of signal in the coil easily. The magnitudes of induced EMF for different number of turns are shown as in fig. 6.

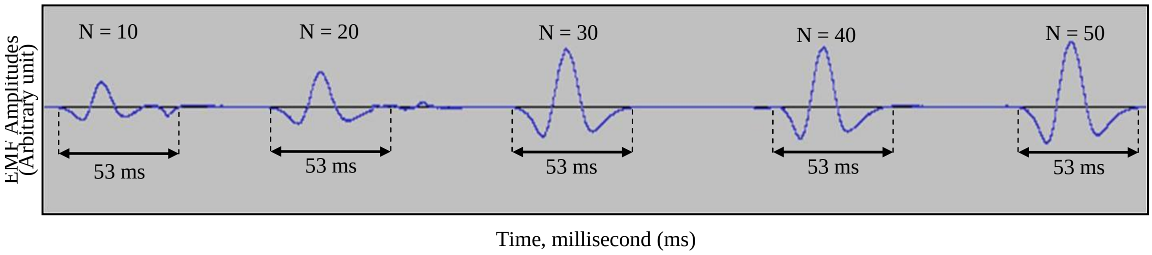


FIGURE 6. THE INDUCED EMF SIGNAL FOR DIFFERENT SET OF NUMBER OF TURNS, N

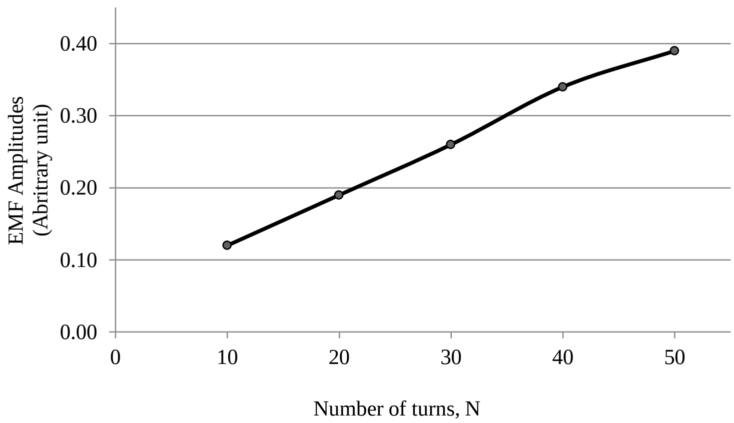


FIGURE 7. THE INDUCED EMF AGAINST NUMBER OF TURNS

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The results obtained are in accordance to the theory of the induction where the induced EMF is directly proportional to the number of turn of the coil provided the speed of the moving magnetic cylinder and the diameter of the coil are constant. Fig. 7 shows peak-to-peak EMF (EMF_{pp}) against the number of turn of coil. The EMP_{pp} increases as the number of turn of the coil increases.

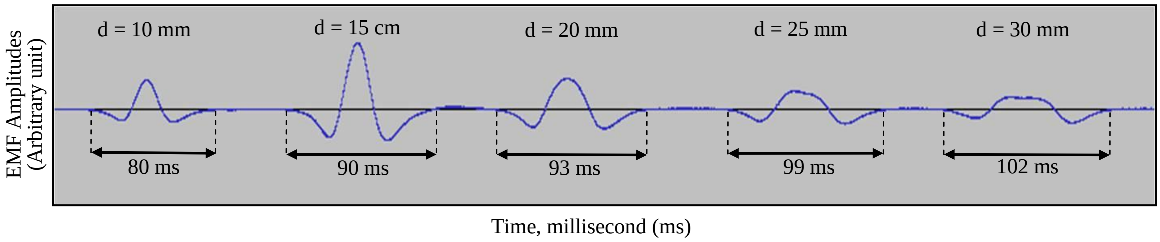

FIGURE 8. THE INDUCED EMF FOR DIFFERENT SET OF DIAMETER OF COILS

Fig. 8 shows the induced EMF signal for different diameter of the coil provided the speed of the moving magnet and the number of turns of the coil are constant. The shape of the signal also shows the width of the signal increases as the diameter of the coil increases or the rate of change of the flux decreases. The amplitude of the EMF_{pp} is optimum around 15 mm and decreases as the diameter of the coil increases because the effective area is depending on the diameter of the moving magnet as shown in Fig. 9.

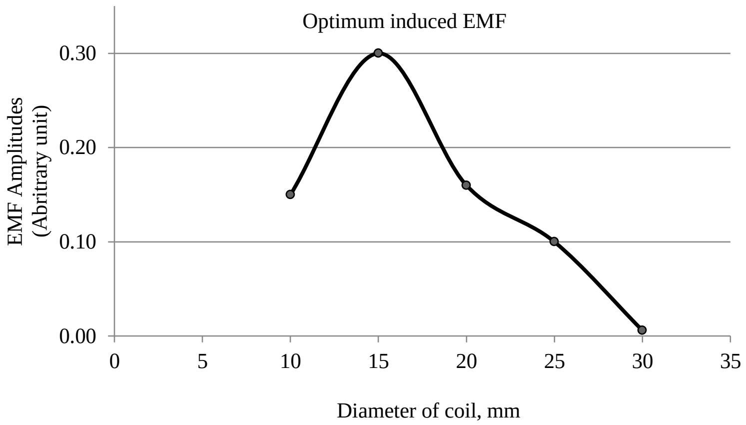

FIGURE 9. THE INDUCED EMF AGAINST DIAMETER OF COILS

The graphical presentation of magnitude of the induced EMF, the velocity of the moving magnet and the time take to cross the coil as shown in Fig. 10.

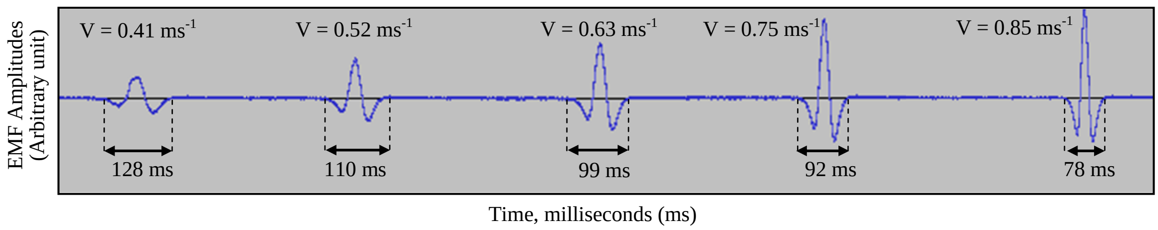

FIGURE 10. THE INDUCED EMF FOR DIFFERENT VELOCITY OF MAGNET

Fig. 11 shows the relationship between the induced EMF in the coil and the velocity of the moving magnet across the coil. The result has shown that, the magnitude of the induced EMF increases as the velocity of the moving magnet become faster this is because the rate of change of the magnetic flux increases.

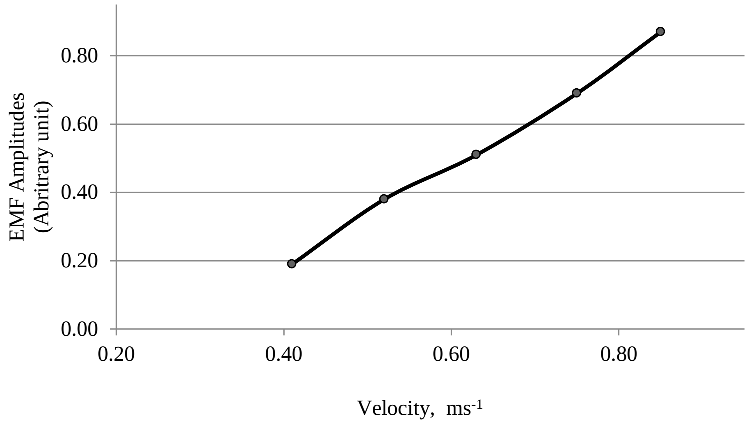

FIGURE 11. THE INDUCED EMF AGAINST VELOCITY OF THE MAGNET

IV. CONCLUSION

In this article, we have shown an alternative induction experiment activities to make student perform, observe and prove the principle of electromagnetic induction. Students will be able to conduct the experiments by themselves and enhance the concept of induction related to the effect of the number of turns, diameter and the velocity of the moving magnet on the induced EMF in the coil. The proposed activities provide students with the opportunity to perform experiments by using low cost experimental kit and a freeware from internet. In this regard, we stress the advantages of Audacity since it allows students to have an immediate feedback on the effect of parameter variation.

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PE – 02

Learning Difficulties Analysis of the Students of Pendidikan Fisika Universitas Ahmad Dahlan to the subject Evaluasi Proses dan Hasil Belajar Fisika

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Abstract— Every student has a differences, it can be in physical, emotional, intellectual, or social, so the learning achievement can be different too. Students who get low on learning achievement usually regarded as troubled students. The cause of this situation can be revealed by diagnosing the difficulty of learning and ease the way to solve it. The subject Evaluasi Proses dan Hasil Belajar Fisika is a kind of difficult subject, it shown from the result of the student that far from satisfying. The learning difficulties of the student can be known from these four indicators: learning difficulty that comes from their self, learning difficulty that comes from the environmental lecture, learning difficulty that comes from their family, and learning difficulty that comes from the society. The sample of this research are students of Pendidikan Fisika Universitas Ahmad Dahlan 2015/2016 5th Semester shows that 13% of students had a very high difficulty, 27% of students had a high difficulty, 35% of students had a low difficulty and 25% of students had a very low difficulty.

Keywords: *diagnosis, learning difficulty, evaluasi proses dan hasil belajar*

I. INTRODUCTION

Teaching and learning is the main activity in educational process. The educational objectives can be achieved in the form of behavior within students, and has been the hope of all parties that every student can achieve their best according to their ability. Due to the successful achievement of educational objectives much depends on the learning process experienced by students as a learner [1].

In the process of learning, lecturer always wishes the best for their students. In fact, many students show symptoms that they cannot achieve the expected learning outcomes. Some students still get low grade though lecturers has given their best efforts. In a course process, lecturers are facing a problem that their student cannot attend the course smoothly. In other words lecturers are facing students with difficulty in learning [1].

Every student has their own characteristic that differ each other. Either in physical aspect, emotional, intellectual, and even social, so that their learning achievement they gain will be different too. Students who get low grade, usually regarded as a student with learning difficulties. But not all of the lecturers, teachers and parents know well about learning difficulties, how the symptoms and causes and how the diagnosis.

The cause of low grade achieved by student can be known by diagnose the learning difficulties, is that comes from themselves, learning environment, family, or come from the society. So the diagnosis is the way to know the cause of learning difficulties and ease us to resolve it. The “Evaluasi Proses dan Hasil Belajar” subject still assumed as a difficult subject to learn, it’s indicated from the student face a difficulty on analyzing question items, so that the students get a low grade.

From assumption above, the author interested to find and know the learning difficulties experienced by the students. If the difficulty not eradicated soon it will hamper the objective of learning process and the objective of learning will not be achieved. So that, analysis in order to know the learning difficulties of the student on the “Evaluasi Proses dan Hasil Belajar” subject must be done by lecturer and other parties that involved in education. Kind of difficulties and caused factor to the student need to be known as soon as possible to find alternative solution. It is aimed to prevent their difficulties keep drag on and brought up to a higher level.

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II. Learning Difficulty

Learning activities for each student not always occur naturally. Sometimes smoothly done, sometimes not, sometimes they can get what have to be learned, and sometimes it feels so difficult. Even high-spirited student, sometimes can be hard to concentrate. This fact is that we often encounter on the students in real life in relation to learning activities. Every student is different. This difference is the factor that caused a different habit to each student. According to what reference [2] has said that learning difficulties is a condition in learning process that characterized by a presence of barriers to achieve the expected result.

III. Learning Difficulties Diagnosis

Every student is certainly eager for their study went smoothly and worked well. No student that expect a failure in their study, even though the reason for their study is not clearly defined. Failure will initiate a disappointment, frustration, even affect their psyche, in certain words the success is the main goal of study. In fact study in a college not always went smoothly; there will be one or two things that cause a failure and inhibit the progress of learning also bring out learning difficulties.

According to reference [3], the common cause of learning difficulties can be divided into 4 categories:

1. Learning difficulties that comes from themselves
2. Learning difficulties that comes from learning environment
3. Learning difficulties that comes from their family
4. Learning difficulties that comes from society environment

Each cause will be explained below:

A. Learning difficulties that comes from themselves

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as ICRIEMS, IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

- Body health condition

  Student's learning process will be disturbed when their body health is down. They will occasionally get tired, less spirited, headache and sleepy [3].

- Intelligence

  People who blessed with high intelligence will ease to success in learning [4]. Information will smoothly learn if they have a good intelligence, even though the success not always depends on intelligence.

- Student's attitude on learning

  Student with bad attitude will be disliked by others, and then this student will feel alone and discriminated. This situation can cause disturbance in learning process [5].

B. Learning difficulties that comes from learning environment

- Teaching and learning process

  Way of the teacher delivers the lesson will affect the student on receiving the lesson. Learning in a higher level school is more to deliver and transform lesson from lecturer to students. So how well and persistent the teacher deliver the lesson to student will really affect the success of the student in learning process [3].

- Learning facilities

  To fulfill the task, students will need a lot of books to support the subject they take. Lack of the supporting books will affect the learning process of the students [3].

  Besides that, to support the learning process also they need learning tools. It can be a practicum kit either basic tools in class room. Lack of those tools will obstruct the learning process [3].

- Learning implementation

  Learning materials which is not match to the student's ability to learn will hamper their study. Usually, in the preparation of material the lecturer is just follow the curriculum without comparing their student's ability. It can be not match between their knowledge levels [3]. The unpredicted schedule also can turn down the concentration of the students, sleepy, tire, even affect their health [3].

C. Learning difficulties that comes from family

- Less economy state

  This state will cause:

  a. Less learning tools from parent

  b. Less learning cost including pocket money

  c. Unwell learning places.

- High economy state

  This state will caused the student to be less active on learning, because everything they need is provided by their parents. It may also be spoiled by their parents; parents do not stand to see their son learned the hard way. This condition will inhibit the progress of learning [4].

- Parent's attention and support

  Less attention from parents will lead the student to be free at will. And this situation will inhibit the learning progress too [3].

D. Learning difficulties that comes from the society

- Disturbance from friends

  In principle, there is no prohibition in friends with the opposite sex as long as still in a normal way. However, many dangers which the result of this association will deliver further consequences that disrupt their learning activities [3]. Friends in the study will be great significance for us who are learning. Have a friend is really important in discussion, task assignments, share difficulties, and support each other [3].

- Active in organization and extracurricular

  Active in organization is a good thing to do for student, but if this activity delivers a bad result in learning then it will be a hindrance in learning [3].

IV. RESULT

Table below shows students frequencies that have learning difficulties, 13% in very high level difficulties, 27% in a high level of difficulties, 35% low level difficulties, and 25% with very low level difficulties.

TABEL 1. LEARNING DIFFICULTIES PRECENTAGE

No	Score	Relative Frequency
1	Score 4 (Very High)	13%
2	Score 3 (High)	27%
3	Score 2 (Low)	35%
4	Score 1 (Very Low)	25%
Total		100%

The respond from the respondent is showed in figure 1 below.

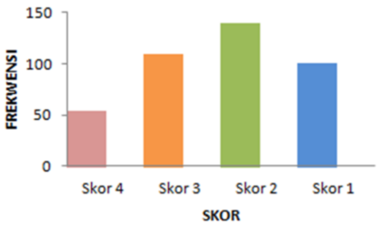

FIGURE 1. STUDENT'S LEARNING DIFFICULTIES LEVELS

The learning difficulties of Pendidikan Fisika Fakultas Keguruan dan Ilmu Pendidikan Universitas Ahmad Dahlan student is in low level. Showed by the result, there are 35% students have learning difficulties. It can be caused by many things, such as themselves alone, campus environment, and society. The difficulty comes from their own, will be hard to identified, and even though it was identified there may be a state to leave that unchanged. Some of them is hard to receive a lesson from lecturers, so it can be an evaluation to them so the lesson can be well delivered to students.

Besides that, there is a lack of mastering of the foreign language (especially English). The learning institute can be the reason why there is a difficulty on learning, it is because student needs guidance from the lecturer and a good facilities.

Family environment can affect too. Economic and control from their parents are a chained factor. Some parents still not control their child on the study progress.

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PE – 03

Development Of Indonesian Qualification Framework (IQF) Level 6 Of Physics Education

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Abstract - This study aims to develop a draf of spesific descriptor IQF Level 6 of Physics Education at Indonesian College. This study is a research and development (R&D) that consists of three phases that include preliminary study, product design, and development. The first phase is preliminary study that consist of : (1) literature study and (2) field study that include need analysis and problem diagnosis. The second phase is product design of IQF Level 6 of Physics Education. The third phase is development that consist of : (1) creating and arranging a draf of spesific descriptor IQF Level 6 of Physics Education and (2) expert validation by colleges and schools. The results show that spesific descriptors IQF Level 6 of Physics Education based on learning outcomes consist of 45 items that contain competences that must be mastered by graduates from Physics Education S1 in Indonesian College. These competences include four principal parameters that consist of (1) skills of work, (2) sciences or knowledges, (3) method and level of ability to apply sciences or knowledge, and (4) managerial ability that in line with discipline of physics education.

***Keywords** : IQF Level 6 and Physics Education*

I. INTRODUCTION

One of effects that is felt Indonesia today is the challenge of global competition of employees nationally and internationally. Movement of employees from and to Indonesian can not endured by the protective rules or regulations. Ratification has been done Indonesian to various regional and international conventions, obviously that has put Indonesian as a country that is more open and easily entered by many sectors including the employee sectors or human resources in general and not the exception in the educational world.

Further effects of globalization by the presence of employee competitions is the emergence of unemployment that is estimated due to low quality and competence of workers. According to data from the Central Statistics Corporation as of August 2011, the number of registered unemployed in Indonesian has reached 7.7 million people. The number of unemployed were estimated because of competence of graduates toward the quality of learning outcomes from educational institutions, such as universities with the demands of employment qualifications and competence.

As one of the institutions, all at once the answers to the problems of employee quality, the Ministry of National Education through the General Directorate of Higher Education, supported by the idea from the Directorate of the Trainer and Power of Coaching and Transmigration Ministry has resulted a framework called the Indonesian Qualifications Framework or IQF (General Directorate of Higher Education, 2010: 7). IQF positioned as an equalizer competence of learning outcomes acquired through formal, informal, and non formal education. Learning outcomes are obtained through internalization of knowledge, attitudes, skills, competencies, and the accumulation of work experience (General Directorate of Higher Education, 2010, p. 17). Parameters of the learning outcomes should be mastered by every graduate of an educational institution of the curriculum and learning applied. Learning curriculum arranged and applied by study program greatly affects the quality of the learning outcomes of study program.

M. Rosul Asmawi stated that the demands toward the quality of higher education needs to be improved in order to create a quality output and to ready to plunge into the employee market and to meet national standards (Asmawi, 2005, p.71). The results obtained from this study were the strategy of improving quality graduates in college. The another research related to the quality of graduates' competence is the research that has been done by Suparwoto in 2010 on the performance of a science teacher at elementary, junior high, and senior high school after certification which shows that the professionalism of teachers in the many schools are still very varied including physics teacher at school (Suparwoto et al., 2010, p. 93). In addition, evaluation of learning curriculum in many universities ideally be the first step that was needed to be resolved, but so far that have not found many studies that revealed about learning curriculum in many universities. Furthermore, the Head of Education UNESCO Jakarta Anwar Al Said assessed curriculum in many universities contain plagiarized material and repeat and not relevant to the times and places, especially in Indonesia.

Afzaal Hussain revealed that the core of achievement of curriculum depends on the evaluation process during the development of the curriculum. This is happened because there is no evaluation of the curriculum implemented, then there is no feedback received to revise the curriculum (Afzaal et al., 2011, p. 263). Higher education curriculum development programs should be able to accommodate and serve all the existing value system to achieve the objectives that can be accepted by all parties in accordance with the role and function of each that should really get attention, because the authority and responsibilities of the different do not disrupt efforts to develop curriculum (Trisharsiwi, 2008, p. 380). Furthermore, Moses L. Singgih & Rahmayanti stated that the curriculum of study program is one of the factors that significantly affect the quality of graduate education (Moses L. Singgih & Rahmayanti, 2008, p. 133).

The quality and relevance of education in Indonesia needs to be improved to produce quality graduates. Sumantri said that the policy program to improve the quality and relevance of education includes four aspects are curriculum, staff, facilities and leadership education units (Tritjahjo & Setyorini, 2005, p. 57). Curriculum development should be sustainable and based on the Indonesian Qualifications Framework (IQF), if the curriculum is not suitable with the service users of the college as soon as the contents of the curriculum updated. This is similar to what was said Murray that "Curricullum is, after all, the very substance of the schooling and the raison d'etre for teachers in schools" (Ghufron, 2007, p. 107).

In addition, graduate successes is largely determined by the quality of teachers in the school. Average quality of teacher candidates in Indonseia still low and varied from one another. This is shown by the results of the exam from teacher candidates were done by the Directorate of Educational Personnel prior to the implementation of decentralization of education. The test results showed an average low value on the subjects of skills required to teach. Data center of educational assessment mentioned that the average score obtained by physics teachers is 13,24 from 40 questions that tested (Vincent, 2004, p. 3).

The quality of education in schools today is very varied both in primary education, secondary education, and higher education. This problem has always been associated with a teacher or lecturer as care taker for implementation in education. Act No. 14 of 2005 about Teachers and Lecturers has regulated the qualifications and competences of lecturers and teachers, but has not given a significant impact for improving the quality of education in Indonesia. Therefore, IQF was expected to answer one of these issues. Directur General of Higher Education has formulated a generic descriptor IQF Level 6 for many study programs, including Physics Education Study Program, but have not specific descriptors yet clearly based on the needs of many schools. Development of specific descriptors of IQF Level 6 of Physics Education is the responsibility of all sides, especially the colleges that have S1 Physics Education Study Program. IQF Level 6 of Physics Education is a new policy for the university in Indonesia for determining the minimum standard of competence to achieve the learning outcomes that are determined, so that the expected standard of graduates produced has the same capabilities of a variety of college graduates. Development of specific descriptors IQF Level 6 of Physics Education should involve universities and senior high school in Indonesia.

Based on the above description can be known that problems of the quality of employee, quality of physics teacher, the quality of education in schools, and there is not the specific descriptors IQF Level 6 of Physics Education. Thus need is to research and development of specific descriptors IQF Level 6 of Physics Education as one of the efforts is to improve the quality of education in Indonesia.

II. THEORETICAL BASIS

A. *Physics and Physics Education*

1. *Physics*

Physics is part of science so that studying physics is the same as studying science. Science as a basic foundation of human activities can be viewed from three different viewpoints. The third viewpoint includes : (1) science as a way of thinking; (2) science as a way of investigating; (3) science as a body of knowledge that was resulted by inquiry which consists of facts, concepts, principles, laws, theories, and models (Collette & Chiappetta, 1994, p. 30).

Another opinion about the definition of science expressed by Carin and Sund are stated as follows.

> ".... Science is human activity that has evolved as an intelectual tool to facilitate describing and Ordering the environment. Once one accepts the idea that science does not exist in any of the realm but the mind, it ceases to be a "thing," an entity with is own existence. Though scientific truth or fact is ideally objective, it is subject to human perception and iogic .... As a method, are

> relatively stable and science is Universally applied, while as a body of knowledge, it is constantly changing "(Carin and Sund, 1980 , p. 2).

Thus, it can be stated that the theory of physics always have empirical truth. The conclusion that can be understood from some opinions, physics by collecting data on observations and experiments to study natural phenomena uses scientific attitude or process and the scientific method.

2. Physics Education

Physics education is an interdisciplinary knowledge from science of physics with science of education. Physics education contained in the classification field in science of physics as physics teaching. Physics education can also be included in the classification field of science of education. Physics education is essentially an application of education theory in the context of physics education for instruction. Physics education as a science, as well as other sciences, has the object or subject of study (ontological aspect), a way of obtaining (epistemological aspect), and usefulness (axiological aspect). Physics education have study materials as following (Sukarjo, 2010, p. 9) :

a. Curriculum, which includes theory of physics curriculum development, physics curriculum organization, physics curriculum content, and models of physics curriculum development.
b. Learners and learning actions, which include the theory of the characteristics of learners, the types and how to learn physics, physics learning process hierarchy, and the conditions of learning physics.
c. Educators and teaching actions, which include theory of physics educator characteristics, characteristics of act educate or teach physics, models educate or teach physics, methods or techniques to educate or teach physics, and classroom management system.
d. Environment of Education, which includes theory of physics education regulation, planning and management of physics education, guidance and counseling or career guidance, and the means or media physics education.
e. Assessment, which includes theory of models of assessment of learning physics, techniques of physics assessment, and instruments of assessment physics.

An expert in physics education should be experts in physics and have a depth knowledge for five disciplines at the top, although one of them is usually dominant.

B. Indonesian Qualifications Framework

Sandra Bohlinger stated that this qualification framework is an engine of innovation as the following statement.

> "Countries that introduce a qualifications framework are thereby seeking to make-Reviews their national educational systems more transparent, more innovative and more competitive. Also They aim to improve the match between the educational system and the labor market. Thus Spake, qualifications frameworks are seen as engines of innovation: the point of introducing them is to promote a number of fundamental, long-term reforms "(Bohlinger, 2008, p. 1).

In addition, the Ministry of Higher Education of Srilanka defined that qualification framework is a new framework that aims to improve the quality of higher education and training through recognition and accreditation of qualifications offered by different institutions (Wijeyaratne, 2012, p.1).

European Qualification Framework (EQF) for life long education consists of 8 levels which is defined by a set of descriptors indicating the learning outcomes assessed based on three criteria : knowledge, skills, and competence (Ligija Kaminskienė, 2011, p. 5). The framework has also become a factor in developing Indonesian Qualification Framework (IQF). In the context of EQF, knowledge is described as theoretical and or factual. Skill is described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving the manual dexterity and the use of methods, materials, tools and instruments). Competence is described in terms of responsibility and autonomy. National qualification framework is to facilitate migration (international) for students to continue their studies or move into the labor market (Higher Education Comprises HBO, 2008, p. 3).

Indonesian Qualification Framework (IQF) has been loaded in Presidential Regulation No. 8 of 2012 which states that Indonesian Qualification Framework is a hierarchy framework of the competence and qualifications that can reconcile, equalize, and integrate among the fields of education, job training, and work experience, in order to give recognition of job competence, according to the structure of employment in various sectors (Presidential Regulation No. 8 of 2012). Arranging of IQF has a legal basis that came within in Government Regulation No. 31 of 2006 about the National Vocational Training System, Government Regulation No. 23 of 2004 about the National Professional Certification, and Law No. 30 about Labour. (General Directorate of Higher Education, 2010, p. 7).

IQF has been made based on the needs and specific objectives, which is typical for Indonesia to harmonize education and training system with a career system in the field of work (General Directorate of Higher Education, 2010, p. 16). IQF has also been designed to fit and equal with the developed system of other countries. General qualification framework is composed tiered from lowest to highest based on the ability to work, mastery of the knowledge achieved through education or skill acquired through training.

European Qualifications Framework (EQF) is one of the qualification framework referred to developt Indonesian Qualification Framework (IQF), divide level qualification framework in eight levels from the first level until the highest level eight (Cedefop, 2010, p. 17). EQF has equalized level qualification in education or training. The concept of life long education seems strong for underlying development of EQF. The development of IQF also refers to and considers the qualification systems of other countries such as Europe, Australia, England, Scotland, Hong Kong, and New Zealand (General Directorate of Higher Education, 2010, p. 16). It makes qualification included in IQF which can easily be compared and accepted by other countries so that the exchange of students and labor between countries can be done properly.

IQF provides nine levels of qualification, starting from the qualification level 1 as the lowest qualification and qualification level 9 as the highest qualification (Presidential Regulation No. 8 of 2012). Every level of qualification descriptors is also appropriated by considering the condition of the country as a whole, including the development of science, technology and art, supporting the development of sectors of the economy and welfare of the people, and aspects of the builders of national identity that is reflected in Bhinneka Tunggal Ika or Unity, which is a commitment to recognize the diversity of religion, ethnicity, culture, language and art as the characteristic of the Indonesian.
Achieving each level or increasing to a higher level in IQF can schematically be done through four pathways or combination of the four pathways. These pathways are illustrated in Figure 1 which consists of pathways through formal education, professional development, career advancement in the industry, the field of work, or through the accumulation of individual experience (General Directorate of Higher Education, 2010, p. 17).

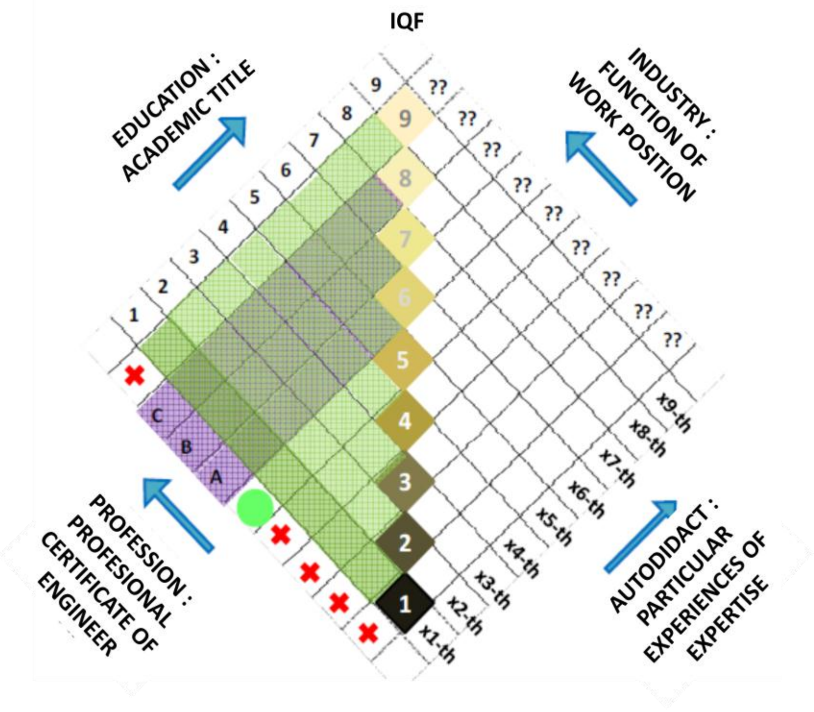

Figure 1. The Level of IQF

Each level of qualification in IQF conceptually composed by four main parameters : (a) job skill, (b) the scope of science or knowledge, (c) the method and level of knowledge or ability in applying the knowledge, and (d) the ability of managerial (General Directorate of Higher Education, 2010, p. 18). These four parameters contained in each level are arranged in the form of descriptors of IQF. Internalization and accumulation of four parameters are achieved through a structured educational process or through work experience called learning outcomes.

Each descriptor of IQF for the same level of qualification can contain or consist of a composition of elements of science, knowledge, expertise (know-how), and skills that vary from one another. Each learning outcomes from an educational can have content more prominent of the skill than science, but given the recognition of hierarchy for equivalent qualification. Figure 2 illustrates that for higher level qualification, the descriptor of IQF will be science, while the lower level qualification will be more emphasise on the mastery of skill (General Directorate of Higher Education, 2010, p. 19).

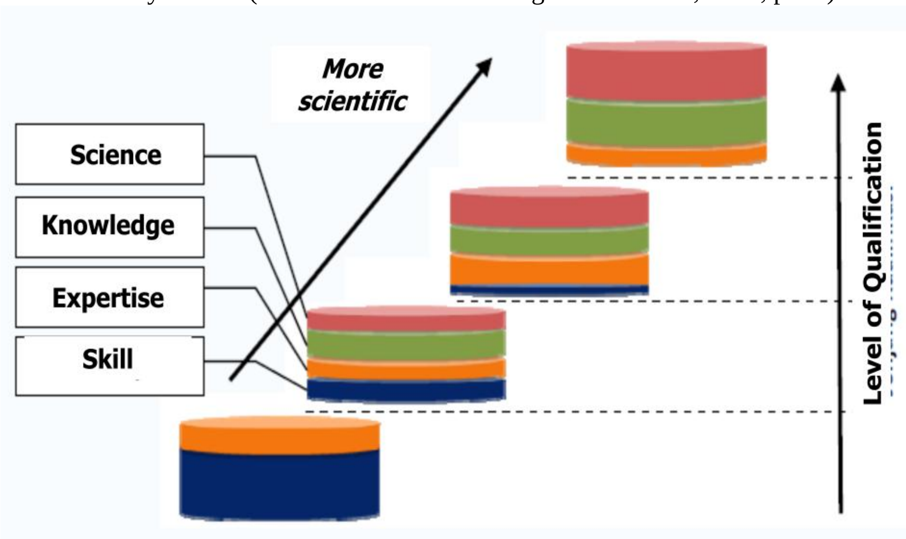

Figure 2. Content of IQF

Explanation.

1. Science is described as a system based on a scientific methodology to build a knowledge through the results from research in the body of knowledge. Ongoing researchs used to build a science should be supported by the data records, observation, and analysis of measured, and aims to increase human understanding of the phenomena of nature and social.
2. Knowledge is described as a mastery of theory and skill by someone in a particular field of expertise or understanding of the facts and information obtained by a person through experience or education for a particular purpose.
3. Expertise (know-how) is described as a mastery of theory and skills by someone in a particular field of expertise or understanding about the methodology and technical skill obtained a person through experience or education for a particular purpose.
4. Skill is described as psychomotor abilities (including manual dexterity and the use of methods, materials, tools, and instruments) achieved through measurable training based on the knowledge or understanding (know-how) that someone is able to produce a product or performance which can be assessed both qualitatively and quantitatively.
5. Affection is described as an attitude of a sensitive person toward aspects around her or his life grown by the instruction and the environment of family or society largely.
6. Competence is the accumulation of a person's ability to implement a job description measurely through a structured assessment, aspects of self-reliance and individual responsibility in the field of work.
7. Learning outcomes are an internasilisasi and accumulation of science, knowledge, skill, affection, and competence achieved through a structured educational process and including a field of science, specific expertise, or through work experience (Higher Education, 2010, p. 20).

IQF is a realization of the quality and identity of Indonesia in the national education system, the national vocational training system and the system of recognition of national competence, it is intended as a guide as follows.

1. Establishing qualification of learning outcomes obtained through formal education, non-formal education, informal education, training or work experience;
2. Establishing recognized scheme of qualification of learning outcomes obtained through formal education, non-formal education, informal education, training or work experience;
3. Balancing qualification between learning outcomes obtained through formal education, non-formal education, informal education, training or work experience;

4. Developing a method and system of recognition of qualifications of human resources from other countries who will be working in Indonesia (Higher Education, 2010, p. 9).

C. Descriptors of IQF Level 6

Descriptors of IQF are divided into two parts : a general description which describes the character, personality, attitude to work, ethics, morals of every human Indonesia at every level; and specific descriptions which describe the skills, practical knowledge, science, knowledge that is mastered by a person depends on the education level (Higher Education, 2010, p. 21). General descriptions of IQF Level 6 indicate suitability with the ideology of state and the culture of Indonesia. Curriculum and learning process that are applied in the study program should be able to develop the following affections.

1. Obeying to God Almighty.
2. Having the moral, ethics, and good personality in finishing the task.
3. Serving as a citizen who is proud and love of the homeland and support world peace.
4. Having ability to work together and having a social sensitivity and high attention for the society and the environment.
5. Respecting for diversity of cultures, views, beliefs, religious, and opinions or original finding from other people.
6. Upholding the rule of law and having the spirit to give priority to importance of the nation and the wide community.

Generic descriptions of IQF Level 6 consist of four paragraphs. The first paragraph is able to utilize science and technology in the field of expertise and able to adapt to situations encountered in solving the problem. The second paragraph is mastering theoretical concepts in the field of indepth knowledge of specific areas, and able to formulate procedural problem solving. The third paragraph is able to take a strategic decision based on the analysis of information and data, and able to provide guidance in selecting various alternative solutions. The fourth paragraph is responsible for his own work and can be given responsibility for the achievement of the organization's work. These generic descriptors become a base in the development of specific descriptors of each study program for developing curriculum in Indonesia.

III. STUDY METHODS

A. Type of Study

This study is included research and development which follow development steps of model of Borg and Gall (1983: 772) modified according to needs of study.

B. Time and Place of Study

This study was done in Physics Education Study Program S1: Yogyakarta State University (UNY), Indonesian Education University (UPI), Sriwijaya University (UNSRI), Lambung Mangkurat University (UNLAM), Pattimura University (UNPATTI), and Nusa Cendana University (UNDANA), as well as and several senior high schools in Yogyakarta, Bandung, Palembang, Banjarmasin, Ambon, and Kupang on October 2012 until February 2013.

C. Subjects of Study

Subjects of this study consist of the colleges and the schools which become expert validation in the development of specific descriptors IQF Level 6 of Physical Education. The universities consist of 54 lecturers and 180 students of Physical Education Program S1 of Yogyakarta State University (UNY), Indonesian Education University (UPI), Sriwijaya University (UNSRI), Lambung Mangkurat University (UNLAM), Pattimura University (UNPATTI), and Nusa Cendana University (UNDANA). The schools consist of 108 physics teachers and 36 headmasters of senior high school in the Yogyakarta, Bandung, Palembang, Banjarmasin, Ambon, and Kupang. Determination of the number of subjects in this study uses nonprobability sampling technique, namely sampling technique that does not give equal opportunity for each element or member of the population to be selected into the sample.

D. Procedures of Study

The procedures of this study follow model of Borg & Gall modified according to needs of study which includes three steps : preliminary studies, product design, and development. The first step is preliminary study consisting of: (1) the study of literature and (2) a field study that includes a needs analysis and diagnosis of the problem. The second step is product design of IQF Level 6 of Physics Education. The third step is development which consists of: (1) creating and arranging a draft of specific descriptor IQF Level 6 of Physics Education and (2) validation of experts by the colleges and schools. The study steps is as figure 3.

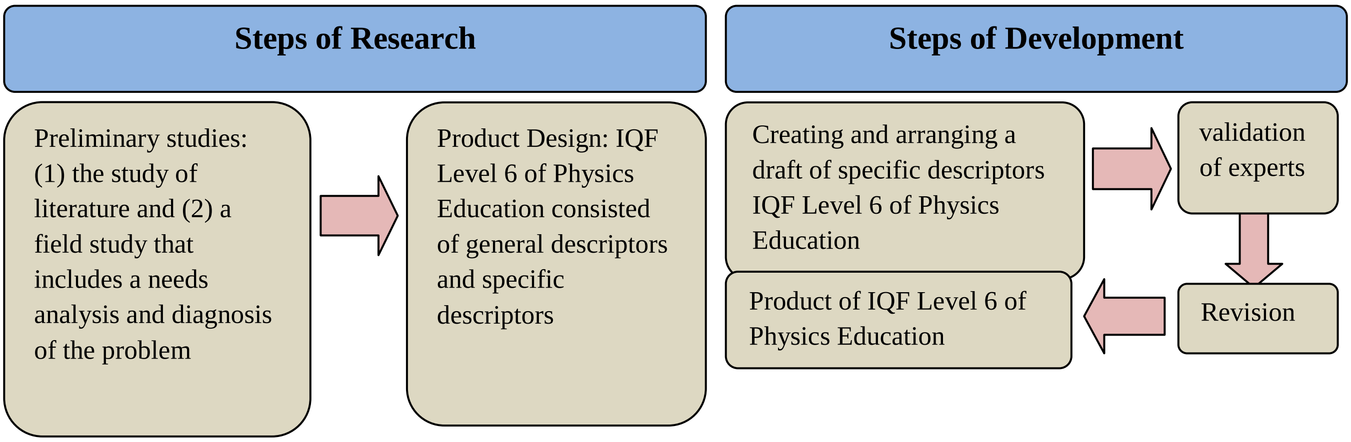

Figure 3. Steps of Study

E. Data Analysis Techniques

Data collected from the validation of experts is analyzed by using quantitative description, and validity of the data was done by using triangulation of data sources from the colleges and the schools. Quantitative descriptive technique is used to determine the level of trend in the variable. Therefore, it is necessary to determine the mean ideal (MI), the standard deviation of ideal (Sdi), and the highest score and lowest score of ideal each sub-variables as criteria. Calculation of the mean ideal (MI) and the standard deviation of the ideal (Sdi) refers to Glas and Hopkins (Glas and Hopkins, 1984, p. 81). The steps of the analysis are as following.

1. Calculating total score of each sample on each variable.
2. Calculating total score of ideal on each variable.
3. Calculating mean ideal (Mi), namely Mi = 1/2 (highest ideal score + lowest ideal score).
4. Calculating standard deviation of ideal (Sdi), namely = 1/6 (highest ideal score - lowest ideal score).

Trend level is divided into four categories as shown in Table 1.

Table 1. Category of Variable Assessment

No	Score range	Category
1.	$X \geq Mi + 1{,}8\ Sdi$	SA
2.	$Mi \leq X < Mi + 1{,}8\ Sdi$	A
3.	$Mi - 1{,}8\ Sdi \leq X < Mi$	DA
4.	$X < Mi - 1{,}8\ Sdi$	SDA

If Mi = 112,5 and Sbi = 22,5, the trend level in table 1 as shown in Table 2.

Table 2. Category of Variable Assessment

No	Score range	Category
1.	$X \geq 153{,}0$	SA
2.	$112{,}5 \leq X < 153{,}0$	A
3.	$72 \leq X < 112{,}5$	DA
4.	$X < 72$	SDA

Description of category :

SA = Strongly Agree
A = Agree
DA = Disagree
SDA = Strongly Disagree

IV. RESULTS AND DISCUSSION

A. Description of Study Data

Specific descriptors IQF Level 6 of Physics Education is developed from generic descriptors IQF Level 6. Specific descriptors developed have 45 points, all of which is a explanation from four paragraphs of generic descriptors IQF Level 6. Total score of assessment from the universities is as Table 3.

Table 3. Assessment from Higher Education

No	Colleges	Lecturers			Students		
		Total Score	**(%)**	**Category**	**Total Score**	**(%)**	**Category**
1	UNY	169,7	94,3	SA	164,2	91,2	SA
2	UPI	166,7	92,6	SA	163,5	90,8	SA
3	UNDANA	174,3	96,9	SA	172,2	95,7	SA
4	UNSRI	179,0	99,4	SA	168,7	93,7	SA
5	UNPATTI	167,0	92,8	SA	168,2	93,4	SA
6	UNLAM	170.3	94.6	SA	168.7	93.7	SA

Assessment from the school is done by involving headmasters and physics teachers in six cities around the universities. The total score of assessment from the schools is as Table 4.

Table 4. Assessment from Senior High School

No	Senior High Schools	Physics Teachers			Headmasters		
		Total Score	**(%)**	**Category**	**Total Score**	**(%)**	**Category**
1	Yogyakarta	167,3	93,4	SA	165,0	91,7	SA
2	Bandung	161,2	89,5	SA	156,0	86,7	SA
3	Kupang	164,2	91,2	SA	156,0	86,7	SA
4	Palembang	167,3	93,0	SA	171,0	95,0	SA
5	Ambon	165,8	92,1	SA	152,0	84,4	A
6	Banjarmasin	167,2	92,9	SA	162,0	90,0	SA

B. Discussion

Specific descriptors IQF Level 6 of Physics Education is developed from generic descriptors IQF Level 6. This specific descriptors is developed from four generic descriptors IQF Level 6 that became 45 grains of competence that must be possessed by graduates of Physics Education Program S1 or physics teacher. Assessment and validation of experts is done by universities namely lecturers and students of Physics Education S1, and schools that contained of headmasters and physics teachers. The procedures of this study follow model of Borg & Gall modified according to the needs of study which includes three steps : preliminary study, product design, and development. The first step is preliminary study consisting of a literature study and field study which includes a needs analysis and diagnosis of problem. Preliminary study has shown that IQF Level 6 of Physics Education be the first step in improving quality of graduates from Physics Education Program Study S1 in the College of Indonesia. Furthermore, all of the curriculum and the learning process in higher education should lead to achievement of learning outcomes which has been determined.

The second step is the product design of IQF Level 6 of Physics Education. Product design of IQF Level 6 of Physics Education consists of general descriptions, generic descriptors, and specific descriptors. General and generic descriptors from General Directorate of Higher Education have been become a reference in the development of each study program including Physics Education Study Program S1. The third step is the study of development consisting of creating and arranging draft of specific descriptors IQF Level 6 of Physics Education and validation of expert by universities and schools. Creating and arranging this draft of specific descriptors IQF Level 6 are based on learning outcomes to be achieved. Learning outcomes for Physics Education Study Program S1 include physics teacher, physics education research, and education managers. Competence of the learning outcomes refers to four competencies which consist of professional competence, pedagogical competence, social competence, and personal competence. Draft of IQF Level 6 of Physics Education which has been arranged further assessed and validated by the universities namely students and lecturers Physical Education S1 from several universities in Indonesia, and senior high schools namely physics teachers and headmasters of several senior high schools in Indonesia. Result of validation and revision shows the final draft IQF Level 6 of Physics Education that can be used as a reference in developing of curriculum for Physics Education S1 in Indonesian Higher Education and as a reflection of competencies that must be owned by a physics teacher.

The results of the assessment from universities are as in Table 3. The total score of assessment from lecturers of Physical Education S1 toward specific descriptors IQF Level 6 of Physics Education, namely: a) UNY 169,7 or 94,3% by category SA (Strongly Agree), b) UPI 166,7 or 92.6% by category SA (Strongly Agree), c) UNDANA 174,3 or 96,9% by category SA (Strongly Agree), d) UNSRI 179,0 or 99,4% by category SS (Strongly Agree), e) Unpatti 167,0 or 92,8% by category SA (Strongly Agree), and f) UNLAM 170,3 or 94,6% by category SA (Strongly Agree). These assessment results show that the lecturers of Physical Education S1 from several universities in Indonesia strongly agreed with the specific descriptors which have been made.

The total score of assessment from students of Physical Education S1 toward specific descriptors IQF Level 6 of Physics Education, namely: a) UNY 164,2 or 91,2% by category SA (Strongly Agree), b) UPI 163,5 or 90,8% by category SA (Strongly Agree), c) UNDANA 172,2 or 95,7% by category SA (Strongly Agree), d) UNSRI 168,7 or 93,7% by category SA (Strongly Agree), e) UNPATTI 168,2 or 93,4% by category SA (Strongly Agree), and f) UNLAM 168,7 or 93,7% by category SA (Strongly Agree). These assessment results show that the students of Physical Education S1 from several universities in Indonesia strongly agreed with the specific descriptors which have been made.

The results of the assessment from schools are as in Table 4. The total score of assessment from school of physics teachers from several regions of Indonesia toward specific descriptors IQF Level 6 of Physics Education, namely: a) Yogyakarta 167,3 or 93,4% by category SA (Strongly Agree), b) Bandung 161,2 or 89,5% by category SA (Strongly Agree), c) Kupang 164,2 or 91,2% by category SA (Strongly Agree), d) Palembang 167,3 or 93,0% by category SA (Strongly Agree), e) Ambon 165,8 or 92,1% by category SA (Strongly Agree), and f) Banjarmasin 167,2 or 92,9% by category SA (Strongly Agree). The assessment results show that physics teachers from several big cities in Indonesia strongly agreed with the specific descriptors which have been made.

The total score of assessment of headmasters from several regions in Indonesia toward specific descriptors IQF Level 6 of Physics Education, namely: a) Yogyakarta 165,0 or 91.7% by category SA (Strongly Agree), b) Bandung 156,0 or 86,7% by category SA (Strongly Agree), c) Kupang 156,0 or 86,7% by category SA (Strongly Agree), d) Palembang 171,0 or 95,0% by category SA (Strongly Agree), e) Ambon 152,0 or 84,4% by category S (Agree), and f) Banjarmasin 162,0 or 90,0% by category SA (Strongly Agree). The assessment results show that headmasters from several big cities in Indonesia strongly agreed with the specific descriptors which have been made.

The first paragraph of generic descriptors IQF Level 6 explains that S1 graduates should be able to use science and technology in the field of expertise and able to adapt toward situations encountered in problem solving. These generic descriptors are described or explained into three specific descriptors. The second paragraph of generic descriptors IQF Level 6 explains that S1 graduates must master the theoretical concepts in the field of indepth knowledge of specific areas, and able to formulate procedural problem solving. These generic descriptors are described or explained into two specific descriptors.

The third paragraph of generic descriptors IQF Level 6 explains that S1 graduates should be able to take strategic decisions based on analysis of information and data, and give guidance in selecting various alternative solutions. These generic descriptors are described or explained into two specific descriptors. The fourth paragraph of generic descriptors IQF Level 6 explains that S1 graduates must be responsible for their own work and able to be given responsibility for the achievement of the organization's work. These generic descriptors are described or explained into three specific descriptors.

The specific descriptors of the first paragraph of generic descriptors, namely: a) having capability for using ICT in physics instruction, b) having capability for using laboratory equipment in physics instruction, and c) having capability for using creating a simple laboratory equipment to support physics instruction. The criticisms or suggestions for specific descriptors "having capability for using ICT in Physics instruction" are namely: 1) the concept of ICT is directed to on-learning or on Campus and to development of competence, professional, and pedagogical physics teacher, 2) there is not only able to use, but also able to create and perform a hyperlink in a power point, 3) it needs to be reviewed by the facilities and infrastructure related to the Internet, 4) assessment is done manually to avoid when there are trouble about ICT, 5) learning process can be interesting and simple. The criticisms or suggestions for the first specific descriptors of the first generic descriptors indicate that the various sides strongly agree and demand that graduates of Physics Education S1 or a physics teacher must mastery of ICT for instruction.

Thus the first specific descriptors of the first paragraph of generic descriptors that have been approved by various sides are as following.

1. Having a mastery of basic concepts about ICT.
2. Having ability to design physics instruction based on ICT.
3. Having ability to apply physics instruction based on media of audio, visual or audio-visual.
4. Having ability to apply physics instruction based on multimedia for presentation.
5. Having ability to implement physics instruction based on website (e-learning).
6. Having ability to use ICT as a medium of communication for teacher and student.
7. Having ability to use ICT for assessment of physics instruction.

The criticisms or suggestions for the second specific descriptors of the first paragraph of generic descriptors "having ability to use laboratory equipment in physics instruction" are namely : a) graduates need to be furnished with maintenance capabilities for the damaged laboratory equipment and b) laboratory instruction is easier to be remembered than the theoretical. The criticisms or suggestions on the second specific descriptors of the first paragraph of generic descriptors indicate that the various sides strongly agree and demand that graduates Physics Education S1 or physics teachers should be able to use laboratory equipment in physics instruction. Thus the second specific descriptors of the first paragraph of generic descriptors that have been approved by various sides are as following.

1. Knowing the various laboratory equipment to be used in physics instruction.
2. Mastering the steps to use various laboratory equipment of physics and having the ability maintenances or repairs.
3. Mastering the concept shown quantitatively by various laboratory equipment.
4. Having the ability to organize or string up various laboratory equipment in various physics experiment.

The criticisms or suggestions for the third specific descriptors " having capability for using creating a simple laboratory equipment to support physics instruction" are namely 1) a laboratory equipment made must meet the rules of observable, measurable, and reasonable, 2) it can make the students to be active, and 3), it is better to use a real equipment. The criticisms or suggestions for the third specific descriptors of the first paragraph of generic descriptors show that the various sides strongly agree and demand that graduates Physical Education S1 or physics teacher should be able to create a simple laboratory equipment to support physics instruction. Thus the third specific descriptors of the first paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to use the local potential or used items in environment to be used as laboratory equipment to support physics instruction.
2. Having ability to create a simple laboratory equipment to support physics instruction.

The specific descriptors of the second paragraph of generic descriptors are namely : a) having professional competence for physics instruction and b) having pedagogical competence for physics instruction. The criticisms or suggestions for specific descriptor "having professional competence for physics instruction " are namely: 1) in order to instruction can become effective and the route of instruction is clear, 2) physics teachers must master the concepts of physics, 3) the competence must be taught and developed in lecture process. The criticisms or suggestions for the first specific descriptor of the second paragraph of generic descriptors indicates that various sides strongly agree and demand that graduates Physical Education S1 or physics teacher must have professional competence for physics instruction. Thus the first specific descriptors of the second paragraph of generic descriptors that have been approved by various sides are as following.

1. Mastering the material, structure, concept, and the mindset of science that supports subject of physics.
2. Mastering the competency standard or basic competency for subject of physics.
3. Having ability to develop matter of physics creatively.
4. Having ability to develop professionalism continually with commit a reflective action.

The criticisms or suggestions for specific descriptors " having pedagogical competence for physics instruction " are namely : 1) it needs strongly supported by development of curriculum, 2) it is one of main competencies that must be had by teachers, 3) it is very important for a teacher for developing curriculum as well as instruments that can support. The criticisms or suggestions for the second specific descriptors of the second paragraph generic descriptors indicate that various sides strongly agree and demand that graduates Physical Education S1 or physics teachers must have pedagogical competence for physics instruction. Thus the second specific descriptors of the second paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to recognize characteristics of students either physical, moral, social, cultural, emotional aspects and intellectual aspects.
2. Mastering instruction theories and principles of educational instruction.

3. Having ability to develop a physics curriculum as well as instruments that can support.
4. Having ability to organize educational physics instruction.
5. Having ability to facilitate development of potential students to actualize their potential (talent development).
6. Having ability to communicate effectively, empathetic, and polite with students.
7. Having ability to conduct assessment, evaluation of processes, and results of physics learning.
8. Having ability to use results of assessment and evaluation for importance of physics instruction.
9. Having ability to do reflective action for improving quality physics instruction.

The specific descriptors of the third paragraph of generic descriptors are namely: a) mastering educational research methods in physics instruction and b) mastering knowledge of guidance and counseling in physics instruction. The criticisms or suggestions for specific descriptors " mastering educational research methods in physics instruction " are namely : a) in order to increase professionalism and quality of the teacher or educator, b) making actively publication of research results in seminars or journal, and c) it needs to focus in particular research methods. The criticisms or suggestions for these specific descriptors of the first three paragraphs of generic descriptors indicate that various sides strongly agree and demand that graduates of Physical Education S1 or physics teachers must master research methods of education in physics instruction. Thus the first specific descriptors of the third paragraph of generic descriptors that have been approved by various sides are as following.

1. Mastering and applying various methods of educational research (such as class action research, experimental research, evaluation research, and research development).
2. Having ability to use results of research for repairing physics instruction.
3. Having ability to give scientific assistance to colleagues when it is needed.

The criticisms or suggestions for specific descriptors " mastering knowledge of guidance and counseling in physics instruction " are namely 1) because not all learners are able to reveal difficulties in the classroom, so there should be a special guidance from teachers, and 2) not only remedial programs but also enrichment. The criticisms or suggestions for the second specific descriptors of the third paragraph of generic descriptors indicate that various sides strongly agree and demand that graduates of Physical Education S1 or physics teachers must master knowledge of guidance and counseling in physics instruction. Thus the second specific descriptors of the third paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to give guidance for students who have difficulty in physics instruction.
2. Having ability to give right solution for students who have difficulties or problems in physics instruction.
3. Having ability to use findings of guidance and counseling from instruction for remedial and enrichment programs.

The specific descriptors of the fourth paragraph of generic descriptors are namely: a) having ability as a physics teacher, especially in planning, implementation, and assessment of physics instruction as well as be able to develop themselves, b) having a personal competence, and c) having a social competence. The results of study show that there are not criticisms or suggestions for these three specific descriptors. Assessment results show that every point in category SA (Strongly Agree). Thus the first specific descriptors of the fourth paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to make a planning of physics instruction (such as syllabi, lesson plans, worksheets, teaching materials, and evaluation instruments).
2. Having ability to perform physics instruction according to planning of physics instruction appropriate steps correctly.
3. Having ability to always endeavor for improving professionalism through self-learning, such as take training, courses, workshops, and seminars.
4. Having ability to give suggestion or innovative ideas to build a school.

The second specific descriptors of the fourth paragraph of generic descriptors that have been approved by various sides are as following.

1. Having ability to act according to religious norm, law norm, and social norms, as well as national culture norm of Indonesia.
2. Having ability to present personality who is honest, noble, and model for students and community.
3. Having ability to present personality who is steady, stable, mature, wise, and authoritative.

4. Having ability to demonstrate work ethic, high responsibility, sense of pride to be a teacher and a sense of confident.
5. Upholding ethical code of teaching profession.

The third specific descriptors of the fourth paragraph of generic descriptors that have been approved are by various sides are as following.

1. Having ability to inclusive attitude, objective and non-discriminatory act for consideration gender, religion, race, physical condition, family background and socioeconomic status.
2. Having ability to communicate effective, empathetic, and polite with fellow educators, staff, parents, and community.
3. Having ability to adapt in task place in entire region of Indonesia which has a social and cultural diversity.
4. Having ability to communicate with the community's own profession and other professions by oral language, written language, or other form.

Based on above description shows that side of universities namely lecturers and students of Physical Education Program S1 from several universities and side of schools, namely headmasters and physics teachers from several cities in Indonesia have validated content by form of responses in category SA (strongly agree) toward specific descriptors IQF Level 6 of Physics Education. The specific descriptors outline and explain generic descriptor IQF Level 6, which can be used to ensure and improve quality and competence for graduates of Physical Education Program S1 through application curriculum based on IQF Level 6 of Physics Education in university. These competences include four principal parameters that consist of (1) skills of work, (2) sciences or knowledges, (3) method and level of ability to apply the sciences or knowledge,and (4) managerial ability that in line with discipline of physics education.

V. CONCLUSION

Stakeholders in education include college and school have approved and validated product of development IQF Level 6 of Physical Education to assure and improve quality for graduates of Physical Education Program S1 at universities in Indonesia. These specific descriptors IQF Level 6 of Physics Education which have been developed from generic descriptor IQF Level 6 have 45 items that contain competencies required by graduates of Physical Education Program S1 in Indonesian universities. These competences include four principal parameters that consist of (1) skills of work, (2) sciences or knowledges, (3) method and level of ability to apply the sciences or knowledge,and (4) managerial ability that in line with discipline of physics education.

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PE – 04

The Application Of Gpcm On Mmc Test As A Fair Alternative Assessment Model In Physics Learning

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Abstract—This paper aims to evaluate: (1) feasibility scoring of the modified multiple-choice test (MMC Test) in polytomous, (2) conformity of generalized partial credit model (GPCM) as scoring model of the Physics test, and (3) validity of the MMC Test scored generalized partial credit model as a fair assessment model in Physics learning. This paper describes the advantages of the modified multiple-choice test, the application of GPCM on scoring modified multiple-choice test, and the conformity of scoring of GPCM on the modified multiple-choice Physics test. Therefore, it can be concluded that: (1) the modified multiple-choice can be scored in polytomous, (2) generalized partial credit model is a conformable scoring model of the Physics test, and (3) application of the GPCM on the modified multiple-choice test is a fair alternative assessment model in Physics learning.

Keywords: GPCM, modified multiple-choice test (MMC Test), assessment models, and Physics learning

I. INTRODUCTION

Physics lesson conducted according to Standard Process. Standard Process is a criterion regarding the implementation of learning in the educational unit to achieve Graduates Competency Standards [1]. On Curriculum 2013 the task of a teacher is to make Learning Implementation Plan (RPP) and maximize the learning process. Learning to use a scientific approach to learning is the learning activities to adopt measures scientists in building knowledge consists of observing, ask, try, reason and communicate.

To monitor the process, progress, and improvement of learning outcomes of students on an ongoing basis, the necessary assessments. Educational assessment is the process of collecting and processing information to determine attainment of learning outcomes of students. Implementation of the assessment refers to the Education Standards Assessment criteria regarding the mechanisms, procedures, and assessment instruments learning achievement of students [2]. Rate on the Curriculum 2013 is done in the form of authentic assessment that an assessment instrument that assesses the start of the input, process and results (outputs) of learning includes attitudes, knowledge and skills. Assessment technique used relevant by the scientific learning process, being able to assess the ability of learners in the learning process and results. In addition, the assessment is an activity of collecting individual data that result describe its characteristics [3]. Thus, assessment of learning achievement in physics is an assessment of the results of the learning process of physics which is a number that describes the characteristics of individual learners.

Assessment should: (1) adopting a form similar to the type of PISA and TIMSS questions to encourage learning process contribute to the improvement of science literacy of students and at the same time explore scientific thinking skills, critical, creative, and innovative; (2) emphasize the mastery of high and low level concept with variations of assessment (multiple choice, multiple choice reasoned, the description is limited); and (3) introduce the type of questions that tested both nationally and internationally to students and science teachers [4]. Thus educators need to make an assessment using the model and type of questions varies. To monitor the process, progress, and improvement of learning achievement of students on an ongoing basis, the necessary assessments. Educational assessment is the process of collecting and processing information to determine attainment of learning achievement of students. Implementation of the assessment refers to the Educational Assessment Standards criteria regarding the mechanisms, procedures, and assessment instruments learning achievement of students [2]. Rate on the Curriculum 2013 is done in the form of authentic assessment that an assessment instrument that assesses the start of the input, process and results (outputs) of learning includes attitudes, knowledge and skills. Assessment technique used relevant by the scientific learning process, being able to assess the ability of learners in the learning process and results. In addition, the assessment is an activity of collecting individual data that result describe its characteristics [3]. Thus, assessment of learning achievement in physics is an assessment of the results of the learning process of physics which is a number that describes the characteristics of individual learners.

The test consists of test items. Haladyna [5] says: "A test item is an instruction or quetion that requires a student response and a rule for scoring the response". Menururt this definition, that the test items in the form of a command or a question that requires a response from learners and require a response menskor rules for such learners. Based on the understanding that the test is a test instrument that provides stimulus in the form of a command or a question that requires a response from the test participants. The response generated by the test participants stated in a score that is easy to interpret.

Assessment in education using two kinds of measurement theory, namely: classical measurement theory and modern measurement theory or item response theory (IRT). Classical test theory (CTT) is also called the True-Score Classical Theory, Classical Test Theory is named for the elements of this theory has been developed and applied for a long time, but still survive today [6]. According to the classical theory of measurement of scoring the test results usually done partially based on the steps that must be taken to correct an answer items. Scoring is done every step and score each item participant adds a score obtained by the students of each step, and the ability estimated by raw scores. Model scoring like this is not necessarily right, because the level of difficulty of each step is not taken into account.

One of the modern measurement theory is GPCM. GPCM is the development of PCM, the PCM discriminant items constant or 1 while the value GPCM discriminant vary. PCM is also appropriate to analyze the response to the measurement of critical thinking and conceptual understanding in science [7]. PCM was developed to analyze the test items that require several steps to resolve. GPCM can be applied to tests done with the steps and clear by the testee. Physics achievement test is a test that is done by exact steps. Therefore, GPCM is expected to be applied properly.

The fact that multiple choice tests are more widely used than other forms of testing. This is because the multiple-choice test used to have advantages, among others: (1) the material being tested can cover most of the learning materials, (2) the students' answers can be corrected easily and quickly, and (3) the answers to each question is certainly true or wrong, so that an objective assessment [8]. Although there are also drawbacks to this test, namely: (1) the possibility of learners to guess the answer is still quite large and (2) the thinking of students can not be seen with the real [8]. In addition, the fact that the scoring results of a multiple choice test with dichotomous models, meaning that if the item response is correct was given a score of 1 and if the response is wrong was given a score of 0. Teachers do not use polytomus scoring models that would be more equitable because it considers the item response measures. With this dichotomous scoring models have yet to appreciate the steps of problem solving, because with different error rate to get the same score of 0. As dichotomous scoring models is certainly less fair.

Based on the description above, the need to study the model instrument in the form of a multiple choice test modified by the model scoring with GPCM. The main issue to be raised in this study were (1) whether the test model of multiple-choice modified can be scored in polytomus four categories according to generalized partial credit models and (2) whether the application of GPCM in multiple-choice modified as an alternative model in the assessment of learning physics effective and fair.

In accordance with the problem to be solved, then the purpose of this paper is to evaluate (1) the feasibility scoring of the modified multiple-choice test (MMC Test) in polytomous, (2) conformity of generalized partial credit models as scoring models of the physics test, and (3) the validity of the modified multiple-choice test scored GPCM as a fair assessment models in physics learning.

II. DISCUSSION

1. The Feasibility Scoring of The Modified Multiple-choice Test (MMC Test) in Polytomous

Structure of items'MMC test consists of stem, the option of stem, reason, and the option of reason. The number of options and choices stem reason each of the five, as Figure 1.

(stem)…………..…………………………………..
(option of stem) A….
B….
C…..
D. …
E …

(reason) ………………………………………………
(option of reason) A….
B….
C…..
D. …
E ….

Figure 1. Diagram of items'MMC Test Structure

MMC tests that have these structures, then it can be scored with polytomous scale. The number of selected categories depend on the scoring guidelines. One of the scoring guidelines that can be selected provisions of each category, as follows.

Category-1: if learners wrong in writing the concepts used and the results are wrong. It is indicated by the students answer questions one and also one of the reasons

Category-2: if learners wrong in writing the concepts used but the results can be correct. It is indicated by the students answering questions correctly and grounds wrong

Category -3: if learners correct in writing concepts used but the end result was wrong. It is indicated by learners answer the question wrong and right reasons

Category-4: if learners correct in writing concepts used and the results are correct. It is indicated by the students answering questions correctly and reason also true

Thus, scaling tests MMC was created in polytomus with 4 categories, ie 1, 2, 3, and 4. Characteristics of MMC item test was scored with polytomous 4 categories can be described as the ICC. Figure 2 illustrates the ICC one item of MMC test.

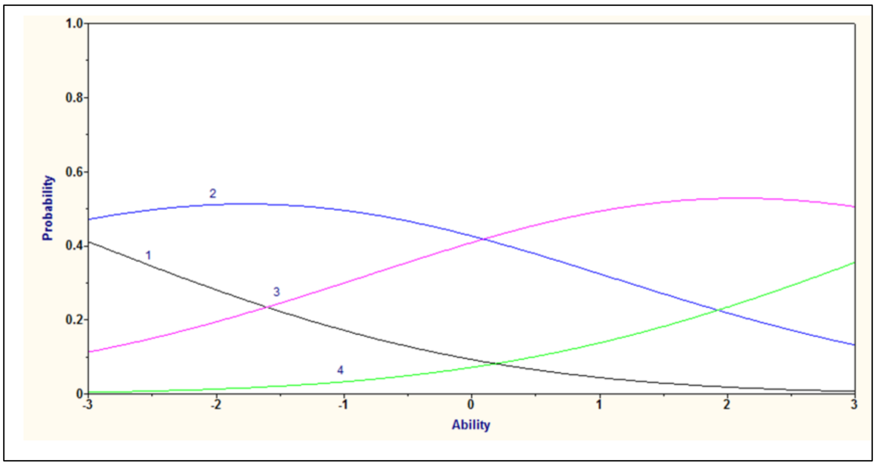

Figure 2. ICC's an item

2. Conformity of GPCM as Scoring Models of The Physics Test

GPCM is the development of PCM. Items' discriminant of The PCM is held exact or 1 while the value of items' discriminant in GPCM vary. PCM is developed to analyze the test items that require several steps to resolve. GPCM can be applied to tests done with the exact steps.

Assessing of tests are based on the steps that can be completed examinees. Although only completed the initial phase alone, examinees are already getting value. The highest value of course obtained when the examinee has completed all phases of the exam questions in that clause. The assessment procedure is virtually identical to how individuals respond to the item in the scale of psychology. For example, an item that provides four categories of responses from 'never', 'rarely', 'often', and 'always' is analogous to the step of completion of such things stated Figure 3. Complete a matter only until the first phase is analogous to the category of 'never' while when it came to the final step, analogous to the category of 'always'. This assumption was later developed into PCM. When it is assumed that a point following the pattern of partial credit the higher the ability of individuals are expected to have a higher score than the individual who has the ability to lower [9]. According to Wright & Masters, PCM is also appropriate to analyze the response to the measurement of critical thinking and conceptual understanding in science [7]. Physics achievement test is a test that is done by exact steps. Thus, the learning achievement tests in physics is perfect score by GPCM.

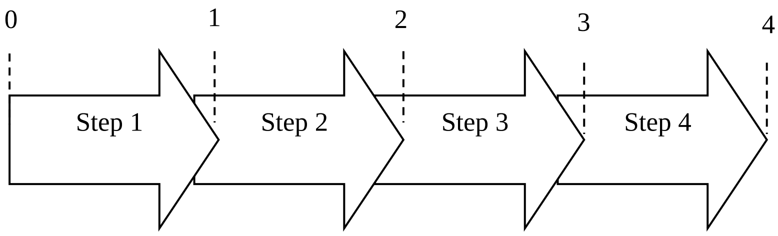

Figure 3.
The scale interpreting is as the step of completion of the item

Figure 4 describe that the test is appropriate for measuring students' physics learning achievement that value from -0.4 to 3.2. This is supported by [10] that modified multiple-choice tests can be to measure students' physics learning achievement. GPCM is scoring model has accurate estimates on the item parameter [11]. Based on the graphs total information function and SEM that the modified multiple-choice tests can be used to measure students' physics learning achievement.

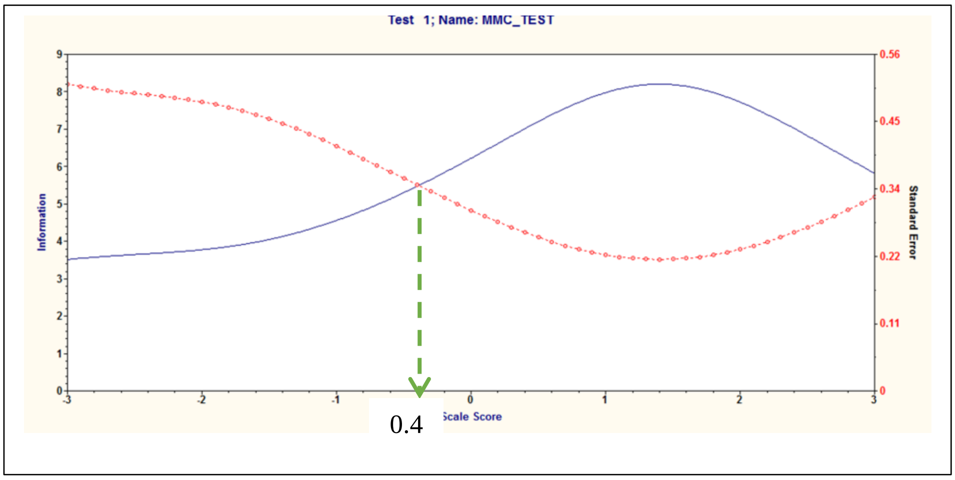

Figure 4 The MMC Test Total Information Function and SEM

3. The Validity of The MMC Test Scored GPCM as a Fair Assessment Models in Physics Learning

The difference classical from modern theory in educational assessment can be illustrated with five students A, B, C, D, and E taking the test as much as 5 items with five response type. To simplify the wrong item was given a score of 0 and a maximum of four given the correct score of 1. Discriminant and difficulty index 5 items found in Table 1. Response of five students is one item wrong and four items correct. If they were scored in classical and modern give different abilities. If classically abilities the five students at 8 all. It is different if it were scored in a modern (GPCM), five students have different abilities with greater sequence namely A, B, C, D, and E. Students' abilities higher if the student is able to do the item whose difficulty index higher.

Table 1. Discriminant and difficulty index 5 items

Item parameter	Item no-				
	1	2	3	4	5
Discriminant	2	1.5	1	0.5	0
Difficulty	-2	-1	0	1	2

Table 2. Students' abilities are scored by CTT and GPCM

Student's ability	Student's Response				
	A 01111	B 10111	C 11011	D 11101	E 11110
GPCM	-1	-0.5	0	1	4
CCT	8	8	8	8	8

If the score of 1 represents a score of 1, 2, 3, and 4, the five students' abilities would be significantly different. It is supported by Kortemeyer, the technique is increasingly used in Physics Education, for example to examine the validity of concept test [12]. Thus, in a modern scoring GPCM is fairer than classical scoring with a dichotomous scale.

III. CONCLUSION AND SUGGESTION

Based on the analysis, the conclusions that can be drawn are as follows:

1. The modified multiple-choice can be scored in polytomous
2. Generalized partial credit model is a conformable scoring model of the physics test
3. Application of the GPCM on the modified multiple-choice test is a fair alternative assessment model in physics learning.

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PE – 05

Critical Thinking Skills Profile of High School Students In Learning Science-Physics

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Abstract-This study aims to describe Critical Thinking Skills high school students in the city of Makassar. To achieve this goal, the researchers conducted an analysis of student test results of 200 people scattered in six schools in the city of Makassar. The results of the quantitative descriptive analysis of the data found that the average value of students doing the interpretation, analysis, and inference in a row by 1.53, 1.15, and 1.52. This value is still very low when compared with the maximum value that may be obtained by students, that is equal to 10.00. This shows that the critical thinking skills of high school students are still very low. One fact Competency Standards science subjects-Physics is demonstrating the ability to think logically, critically, and creatively with the guidance of teachers and demonstrate the ability to solve simple problems in daily life. In fact, according to Michael Scriven stated that the main task of education is to train students and or students to think critically because of the demands of work in the global economy, the survival of a democratic and personal decisions and decisions in an increasingly complex society needs people who can think well and make judgments good. Therefore, the need for teachers in the learning device scenario such as: driving question or problem, authentic Investigation: Science Processes.

Keywords: Profiles, Critical Thinking Skills, interpretation, analysis, inference.

I. INTRODUCTION

Critical thinking skills are skills that must be nourished for students and university students to be able to compete in the 21st century, but to develop the thinking skills including critical thinking skills lies in the skills of the students (National Education Standards, 2006). According Karamustafaoglu (2011), the development of science process skills enable students to construct and solve problems and think critically. This possibility can occur because the components of critical thinking is largely a component of science process skills such as designing experiments, testing hypotheses, hypothesizing, predicting, inferring, classifying, measuring, observing (Hassard, J., 2005, p.332). Thus, if students' science processes skill developed, critical thinking skill will evolve Too. One of the Competency Standards (SKL) in the science subjects demonstrated the ability to think logically, critically, and creatively with the guidance of teachers and showing the ability to solve simple problems in daily life. This means that after following the science lessons, students are expected to have the ability to think critically. However, the background of this study have stated that one of the indicators of non-optimal ability to think, work and behave and communicate science students is poor science process skills of students. Though science process skills can spur the development of a variety of thinking skills of students. From this brief description indicates that students' critical thinking skills should be developed through learning.

According to Michael Scriven, the main task of education is to train students and university students to think critically because of the demands of work in the global economy, the survival of a democratic and personal decision in the complex society needs people who can think well and make good judgments (Jennifer. H, 1998). Therefore, critical thinking is an essential tool that is taught to students and or students to succeed in a world that is increasingly complex and rapidly changing. Brookfield encourages educators to take a critical reflective stance toward teaching and helping students to face their world or environment with compassion, understanding, and justice. When teachers practice critical thinking, it encourages the creation of a democratic classroom (Ozkahraman Yildirim S & B: 2011). Paul believes that critical thinking is an important basis for education to adapt the demands of the 21st century, personally and socially. In view of the rapidly changing world and global reality there is a critical need for individuals to develop skills and abilities that enable them to adapt and respond the demands of the 21st century.

Based on Some experts' opinion regarding the concept of critical thinking skills, the author can state that critical thinking skills are thinking skills that involve high-level cognitive processes, namely interpretation, analysis, evaluation, and inference through scientific procedures in order to solve the problem (Dewey, 1991; Kurfiss, 1991; Burden and Byrd, 2007; Beyer, 2008; Screven, Paul and Angelo, 2008; Rudinow and Barry, 2008). From the definition above, the authors make as an indicator of critical thinking skills in this study is the interpretation, analysis, and inference.

II. RESEARCH METHOD

This study was a descriptive study to reveal the critical thinking skills of high school students. Giving critical thinking skill test to the students of senior high school in Makassar city with the total number of students are 200 persons. Critical Thinking Ability Test (CTAT) of Physics is structured with the following steps: (i) Adapting questions from physics book: Principle and Problems by Zitzewitz, P., W., et. al. The questions which were adapted are the questions that match with the indicators of critical thinking skills, they are; **interpretation, analysis, inference**, (ii) Giving to some colleagues that have background of Bachelor of education, master degree, and doctoral program, for validating readability of physics critical thinking skills question. The technique of data collecting were Critical Thinking Ability Test (CTAT) of physics to measure students' critical thinking skill include high level cognitive processes, namely interpretation, analysis and inference through scientific procedures in order to solve the problem. While the data analysis technique used quantitative descriptive techniques.

III. RESULTS AND DISCUSSION

A. Results

This study aims to describe critical thinking skills of students at several high schools in Makassar. The detailed results of critical thinking skills such as Table 1 below.

TABLE 1. CRITICAL THINKING SKILL'S TEST HIGH SCHOOL STUDENTS

School Name	Indicator Critical Thinking Skills		
	Interpretation	*Analysis*	*Inference*
SMAN 2 Makassar	*1.50*	*0.08*	*0.28*
SMAN 9 Makassar	*0.81*	*0.14*	*0.86*
SMAN 10 Makassar	*1.16*	*0.76*	*0.88*
SMAN 14 Makassar	*0.90*	*0.71*	*2.00*
SMAN 15 Makassar	*1.25*	*0.47*	*1.56*
SMAN 17 Makassar	*3.56*	*4.75*	*3.56*
Number	*9.18*	*6.92*	*9.13*
The average value/ indicator	*1.53*	*1.15*	*1.52*

Remarks: maximum value = 10

Table 2 illustrates that the average critical thinking skills include **interpretations** of 1.53, the **analysis** of 1.15, and the **inference** of 1.52. These values indicate that critical thinking skills are still low when compared with the maximum possible value is achieved by the students, that is equal to the value of 10.00. These results, also happens to students of higher education, namely students' critical thinking skills are still low. Results of Critical Thinking Ability Test (CTAT) of students in detail can be seen in Table 2 below.

TABLE 2. RESULTS OF STUDENT CRITICAL THINKING TEST

Department & Class	Indicator Critical Thinking Skills		
	Interpretation	*Analysis*	*Inference*
Physics Education	*1.50*	*1.91*	*2.20*
Physics Education International Class A	*1.51*	*1.77*	*2.42*
Physics Education International Class B	*1.39*	*0.69*	*0.74*
Number	*4.39*	*4.38*	*5.36*
The average value / indicator	*1.46*	*1.46*	*1.79*

Remarks: maximum value = 10

Table 2 illustrates that the average of students' critical thinking skills include interpretation of 1.46, analysis of 1.46, and the inference of 1.79.

B. Discussion

The general objective of this study is to describe the critical thinking skills of high school students in Makassar. Descriptive analysis of the data found that the average value of students doing the interpretation, analysis, and inference in a row by 1.53, 1.15, and 1.52 (Table 1). This value is still very low when compared with the maximum value that may be obtained by students, that is equal to 10.00. This means that the critical thinking skills of high school students are still very low.

In the Journal "Higher Education Research & Development" (2011) states that to make students as critical thinkers in the learning takes five terms, namely:

(i) the student has the skills and abilities such as how to know, how to evaluate or analyze (Siegel, 1988; Facione , 2006; Khaeruddin, 2013);
(ii) prepare and prepare learning engages students in critical thinking such as reasoning and analysis (Siegel, 1988; Perkins, Jay & Tishman, 1993; Ennis, 1996; Khaeruddin, 2013),
(iii) Understand the involvement in learning and understanding that thinking the construction and evaluation of critical reasoning, not show the correct answer or just opinion (Perry, 1990; Kuhn, 1999; Khaeruddin, 2013);
(iv) Work and meet the criteria to take into account the success of critical thinking (Bailin, Et al., 1999);
(v) The students understand the material (McPeck, 1981).

Based on some opinions in the Journal "Higher Education Research & Development" above, the results of this study show fact that the lack of critical thinking skills of students resulted by the teacher in the learning process, the teacher seldom stimulate the development of science process skills of students and student critics' skills such as: (i) books that are used less stimulating of critical thinking, creative, and innovative, problem-solving; (iii) use worksheets that do not stimulate the development of science process skills; (iv) the learning objectives in a lesson plan does not specifically oriented toward science process skills. The formulation of learning objectives only cognitive-oriented products, but no true purpose which leads to cognitive processes, namely the higher level thinking; (v) test given to students is still largely oriented cognitive products. This is contrary to the opinion of some experts associated with the requirement to make the students as critical thinkers. It is also proved that the learning results of the test device oriented to the development of critical thinking skills. Teachers were confused in teaching using worksheets that can develop students' ability. In fact, they ask for some questions about "what is the manipulated variable, the response variable, the control variable, why there is no procedure works" The results of this trial reinforces that the worksheets used in the learning process has not stimulated the development of science process skills. That is an important aspect in building scientific literacy of students, it didn't works at all, it was not optimal, i.e. the understanding of the terms in the habits and communicate science in science learning. The way students learn and teachers' ability to recognize the students' potential is not maximized.

In fact, the ability of the teachers to recognize students' potential will facilitate preparing, formulating and implementing the curriculum. The curriculum is then used as a tool to assess the level of achievement of student learning. To support the implementation of the science curriculum is needed, instructional materials that can develop science process skills. Therefore, the existence of teaching materials is crucial in the success of learning according to the learning objectives. Teaching materials can bridge the experience with the knowledge of students, the adequacy concept, depth, as well as its application in the context of students' daily life.

Therefore, science teaching materials should be drawn up which provides opportunities for students to develop:

(i) The process skills which include the ability to observe, comparing and contrasting, classifying, measuring, communicating, and the skill of higher level , as predicted , apply concepts, and communicate;
(ii) The ability inquiry;
(iii) The ability to think;
(iv) The ability of scientific literacy in order to understand the science terms (Toharudin 2011: 205).

Thus, science teachers should be good at sorting and selecting strategies according to the characteristics of the science subjects. Learning Science-physics must execute oriented science process skills to cultivate the ability to think, work and behave and communicate scientific as one of the important skills that must be possessed by the student. This is because scientific procedures requiring interpretation in order to solve problems, analysis, and inference, whereas the third indicator is the critical thinking skills that involve high-level cognitive processes (Dewey, 1991; Kurfiss, 1991; Burden and Byrd, 2007; Beyer 2008 ; Screven, Paul and Angelo, 2008; Rudinow and Barry, 2008).

Even the power of learning science in building students 'critical thinking skills lies in the ability to process skills (Science Processes Skills) which stimulate the development of a variety of students' thinking skills and it is the demands of the curriculum 2013 According Karamustafaoglu (2011), the development of science process skills enable students construct and finish problems and think critically. This possibility can occur because the components of critical thinking is largely a component of science process skills such as designing experiments, testing hypotheses, hypothesizing, predicting, inferring, classifying, measuring, observing (Hassard, J., 2005, p.332). Thus, if students' science processes skill developed, critical thinking skill will evolve too. The low critical thinking skills of students, it also happens to a university student. This is shown by the average student critical thinking skills include interpretation of 1.46, analysis of 1.46, and the inference of 1.79 (Table 2). The low critical thinking skills of university students is because they are still getting used to the pattern of learning at the high school level, given the critical thinking skills test is given to students of the second semester.

In addition, the university students mostly from districts in South Sulawesi , learning pattern is approximately same to 6 schools in Makassar as the place to study, even if the terms of the school is below the level of the school in Makassar. However, generally, critical thinking skills of university students are higher than the high school students. This allows the case because in a period of 6 months in the program study physical education, students of State University of Makassar have been doing practicum oriented to Science Skill Processes. But the difference between university students' critical thinking skills and students were not significant. This reinforces the statement Nur (1998: 22) who says that to develop aspects of students' cognitive skills, not an easy job, it takes a long time to build and develop process skills. O'flahavan and Stein (Brunning, 1995) argues that the skills should be done over and over again , whereas according to the Burden and Byrd categorize critical thinking as a thinking activity that requires a high level of cognitive skills (Irani, Rudd, Gallo, Rickets, Friedel, & Rhoades, 2007). Therefore giving an opportunity to students and university students to think critically is not enough, without realization. So students and university students should use the opportunity continuously.

IV. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of research and discussion, it can be concluded that: Critical thinking skills of high school students in Makassar is still very low when compared with the maximum value of 10.00 which may be obtained by students, namely the interpretation of 1.53, analysis of 1.15, and the inference of 1.52. To cultivate students' critical thinking skills, necessary learning process in the classroom such as: driving question or problem, authentic Investigation: Science Processes Skills, collaboration, and discussion.

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PE – 06

Online Peer-Assessment in Teaching Physics in English Class for Improving Pre-Service Physics Teachers Learning

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Abstract—this research investigated the effect of online peer-assessment in a Teaching Physics in English class conducted in Physics department Universitas Negeri Malang. Peer-assessment has been applied in several studies, but it has not been applied in foreign language class in Pre-service Physics teacher class particularly in Indonesia context. This research mixed online assessment and peer-assessment during the teaching and learning process in a Teaching Physics in English class. The participants in this study were 20 pre-service physics teachers learning how to deliver Physics in English. This online peer assessment employed WhatsApp as a social media application based on android smartphone allowing real time assessment during teaching and learning process. In the gathering data process, Observation and questionnaire had been employed to describe the situation during this research. This research found that online peer-assessment using WhatsApp group helped students to improve their English skills. This assessment also improved their peer-performance during teaching and learning process. However, it is important to prevent several disadvantages of online peer-assessment in its application such as the time limitation and internet access.

Keywords *Online, Peer-assessment, Pre-service Physic Teachers*

I. INTRODUCTION

Learning English as a foreign language is a challenging. This study reveals that pre-service physics teachers learning how to teach Physics in English also meet the challenges during their learning. Several pre-service Physics teachers felt that their English skills was bad and they had no confident to speak in English.

The researcher found that 20 pre-service Physics teachers in the class have a high motivation to learn English. Most of them took 20s credit in that semester. Most of them also took another English class, which is English for Physics teacher.

They had several reasons to learn English. Most of them have motivation to compete in ASEAN Economic Society. They also want to pursue their study abroad. They also want to open their opportunity to collaborate with other Physics from around the world.

This class is their first class using full English as an instruction language. The students have various English background but they have same background that is hardly communicate actively in English. Therefore, they tend to communicate in Bahasa or Javanese rather than English unless they already understand the grammar and English vocabularies.

This situation motivates the researcher to conduct this research. This research just focuses on the use of assessment to improve students' learning in teaching Physics in English class. The study also wanted to encourage students to learn actively in the class.

II. ONLINE PEER-ASSESSMENT AND ITS ROLE IN PRE-SERVICE PHYSICS TEACHER CLASS

Assessment generally can be grouped as Formative and summative. Peer-assessment conducted in this study is sort of formative assessment. This formative assessment has a function to improve the quality of learning and students' experiences during teaching and learning. This study encouraged the students to be involved actively during assessment process. The involvement of students in a sort of new forms of assessment may improve students' learning in terms of their responsibility and more reflective [1].

Peer-assessment is a new form of assessment. This assessment involves the students' participation during assessment process. The involvement of the students actively during teaching and learning process particularly on assessment process benefits to the students' improvement. Topping [2] found that peer-assessment gave positive effects on students' achievement and attitude as good as effect of lecturer assessment.

Online peer-assessment is a kind of assessment assisted by the advance of Information and Communication Technology (ICT). The use of ICT in the class may reveal positive effect in students' learning. Wenna and Tsai [3] found that the use of online peer-assessment could improve the project and feedback quality of in-service science and mathematics teachers. However, they also found that there was the decrease of teachers' attitude toward online peer-assessment after the period of its application.

The main component of online peer-assessment is how to keep high quality feedback. The feedback enhances the quality of peer-assessment to improve students' learning. Liu and Charles [4] argue that high quality feedback should be kept to encourage students' provide feedback objectively. They found that grader may influence the quality of feedback. Therefore, this research just gave the students to assess their peer performance and gave comment on each online peer assessment.

This study investigates the application of online peer-assessment in a Teaching Physics in English class. This study is a preliminary study to the deeper research regarding the use of ICT in peer-assessment. This study may describe the benefits and the weaknesses of online peer-assessment. The author or Physics educators may benefit to consider the use of online peer assessment in different Physics classes.

III. METHODS AND DESIGN

This research employed qualitative approach during the data collection. The advantages of qualitative research are the number of participant, the deep description of the findings, and high quality data provided by the research.

The author is the lecturer in the Teaching Physics in English class at Physics department Universitas Negeri Malang. Therefore, the researcher knows the real situation and students' background involved in this research. The researcher also analysed the pre research situation before the application online peer-assessment. In this study, the author conducted research alone.

Methods employed in this research were observation, questionnaire and interview. The researcher observed the students' activities during the class particularly before and after the application online peer assessment. Field note was written to describe the real condition in the class. Furthermore, the lecturer also use online questionnaire to gather students' opinion during and after the implementation of online peer-assessment. This questionnaire was made on open ended form to gather various views of the students. Moreover, interview was conducted to collect direct and spotaneous data from the participants.

20 pre-service physics teachers, which are the students at Physics department Universitas Negeri Malang, have been selected in this study. They are the 3rd year student in pre-service Physics teacher program. They took the course as an elective course to enrich their teaching and learning schools before conducting research and teaching experiences in the real schools. The course could be said as the last course class to prepare students in their future teaching and learning life.

WhatsApp has been chosen to be studied in this study because the vast majority of pre-service Physics teachers studying in Physics department Universitas negeri Malang use this application in their daily activities. They also tend to communicate with their lectures particularly the author with this android program. The Physics department Universitas Negeri Malang also communicates the new information and policies through WhatsApp. Before the research has been conducted, the class leader invited the researcher to join the class group discussion on WhatApps. The advantages of the program are the capability to communicate in limited internet connection, the easy access, and the opportunity to display the students' peer-assessment to their friends.

A rubric for online peer-assessment has been provided by discussing the whole Teaching Physics in English lecturers. This discussion enriches the final rubric and can be used in different class. The rubric was designed in a simple way to help the students to learn and use. The rubric can be seen in Table 1 below.

The rubric was introduced to the students before the use. They could ask and discuss how to use the rubric. The research also introduced how to assess their peer-presentation. The students just need to post with provided format. The format is just typing the presenter's name, the assessor's name, categories values, and their comment. The example of the format is Oci #Sandy# Good# Fair # Less# Ochi can explain correctly, but she has fair communication skills, and less interaction with audiences. The students just need to post their marking in WhatsApp class group.

TABLE 1 RUBRIC FOR PRESENTATION ON TEACHING PHYSICS IN ENGLISH

Criteria	Less	Fair	Good
Content **(30%)**	• Less comprehensive **or** • having misconception	• Quite comprehensive **and** • no misconception	• Comprehensive **and** • No Misconception
Communication Clarity **(30%)**	• Unclear Pronounciation and intonation • Using less appropriate word choices	• Quite good Pronounciation and intonation • Using several appropriate word choices	• Quite good Pronounciation and intonation • Using several appropriate word choices
Interaction with the audience **(40%)**	• Less keeping eye contact • Less encouraging audience participation	• Several keeping eye contact • Several encouraging audience participation	• Most keeping eye contact • Most encouraging audience participation

The whole students could see the result of online peer-assessment. The example of students' peer assessment can be seen in Figure 1.

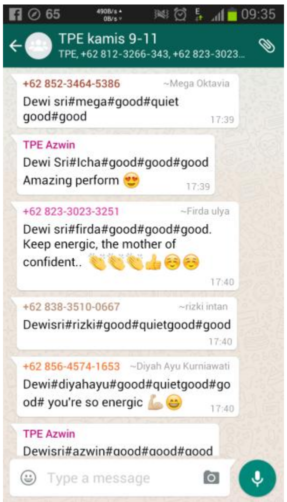

FIGURE 1 STUDENTS' ONLINE PEER-ASSESSMENT

IV. FINDINGS

During the teaching and learning in the class, questionnaire has been administered to gather participants' opinion for online peer-assessment. Three questions have been asked to the students. The questions are listed below.

Does online *peer-assessment help you to learn from your friends?*

Are you *interested in peer assessment to be implemented in the course?*

What *do you think about your friends' comment?*

Participant responds can be seen on Table 2 below.

TABLE 2. STUDENTS RESPONDS REGARDING THE APPLICATION OF ONLINE PEER-ASSESSMENT

NO	Students' Responds
1	Yes. Yes. I think the comment has subjectivity aspect I mean laziness n sleepiness influence the comment
2	Yes. Interested. It is so helpful.
3	Yes i do. Because there are is one sample for assessment. 3. They comment to build and adding experience
4	Yes, because from this assessment we can know what our weakness. Yes, because from this assessment we can know our weakness.
5	Yes I do, peer assessment have trained our skill to assess friends. The friends comment is good for our improvements and I think a several friends comment with the funniest statement. I like that.
6	Yes, I'm interested in peer assessment to be implemented in this course. I think about my friend's comment is most of objective and should be honest so we can learn from our comment and we can improve our skill about English,
7	Yes. Because this peer assessment improve my skill although I feel under pressure before TPE class because my English skill is bad
8	1. Yes, 2. I'm interested in peer assessment to be implemented in this course. 3. i think about my friend's comment is most of subjective and should be honest so we can learn from our comment and we can improve our skill about English.
9	Yes. Many suggest from friends can build my spirit and improve my skill
10	Yes. Because, from the comments of my friends I hope i can do more better next time

11	Yes, I do. Yes, very interested. I think it so fun, because we can to know learn as a commentator , so it can build adding in our experience, and we can more improve our skill again
12	Yes, because it can give me a motivation to improve my skill.
13	Yes. Because, by assessing my friends, directly I must attentive and understand what's my friends' explain.
14	Yes, because I can get feedback directly
15	Yes sir, i think about my friends' comment can improve my skill and do be better before
16	Yes, I do, sir. by assess friends, it make us: understand the content, know where we must improve for next our performance.. it will be better continue this way, sir..

The study found that students have many different marking scores only on the first online peer-assessment. Only two students had similar marking score with the lecturer. After the lecturer gave feedback for marking score and the student's performance, there were improvements of the similar perception between the students and the lecturer in terms on marking score for student's performance.

Students' performance has improved on assessment skills, English skills and presentation skills during online peer-assessment. The students participated on the study had more intention during the application of online peer-assessment. They also tried to use the rubric to assess their peer performance. Compared to the situation before the application of online peer-assessment, the students felt sleepy and lazy because the class was held from 03.00 pm to 5.30 pm. It means that the students already felt tired because of other classes and activities. The students, who are both presenter and assessor, received and thought about the assessed performance based on peer-feedbacks and lecture's feedback. It can be concluded that the whole class would learn each other. The results of this learning situation can be seen from the improvement of the students' performance during presentation assignment.

V. Discussion

Based on the research findings, there are several factors need to be consider before the use of online peer-assessment. First, the lecturer should introduce the rubric and its use during assessment process. The rubric has several advantages i.e. improving student's performance during assessment and doing the assignment. Second, the lecturer should provide feedback during teaching and learning process. The feedback will improve and enhance students' skills and improve the learning process. Third, the lecturer should help the students to learn how to analyse and assess their peer-performance. It is important to learn how to assess other performance particularly for common performance. The students tend to assess differently when the performance of their friends was in common performance. The lecturer should also train the students to assess objectively without friendship consideration. The fourth, the lecturer should consider the internet connection and students' familiarity with the particular software. These factors may influence the success of the research on online peer-assessment.

VI. Conclusion

It can be concluded that online peer-assessment has several benefits. Students could enhance their learning process in the Teaching Physics in English class. Students can improve their English skills and presentation skills using provided feedbacks. Furthermore, students marking score had nearly similar score the lecturer's assessment. The preparation about rubric and internet connection should be considered before applying online peer-assessment. Feedback should be kept objectively to enhance students' learning process.

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PE – 07

The Effect of Guide Note Taking Learning Strategy Toward The Students' Critical Thinking Skill

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***Abstract*—**The students' critical thinking skill in SMAN 7 Banjarmasin is relatively low refers to the students' ability in evaluating argument, giving reason to support conclusion, and making decision, which is deficient, and also the students are not accustomed to record information by noting the important points of material in learning activity. Therefore, researcher did a research to know if the guide note taking strategy in direct instruction learning model has an effect toward the students' critical thinking skill. This research is a quasi-experiment research with nonequivalent group pretest-posttest design. Data is obtained from student's worksheet and critical thinking skill test. Data is analyzed descriptive quantitatively. The research result shows that the guide note taking strategy in direct instruction learning model has an effect toward the students' critical thinking skill with the correlation of 0.97. Researchers conclude that the guide note taking learning strategy in direct instruction setting has positive effect toward the critical thinking skill of XI MIA students in SMA Negeri 7 Banjarmasin.

Keywords: *critical thinking skill, guide note taking.*

I. INTRODUCTION

Education quality is indirectly showed by the students’ learning outcome whereas the outcome itself is not separated from the model, method, and strategy used in the learning process. According to researcher’s observation result, the students’ learning outcome of class XI SMA Negeri 7 Banjarmasin in Physics subject is categorized as low. Students need teacher’s guidance during the learning process and they do not have structured note, so that they need supporting media to help them understand the taught subject, which is the guide note. Other than that, the students’ ability to record information, identify argument, and evaluate information source, is still not good enough which signs that the students’ critical thinking skill is not optimal yet.

The thinking process associated with a variety of custom and requires the active involvement as a thinker [1]. Critical thinking is a disciplined thinking is influenced by intellectual standards: clarity, accuracy, precision, relevance, consistency, logic correctness, completeness and fairness [2]. Critical thinking is independent thinking, self-discipline, self-monitor and self-improvement. This requires appropriate standards regarding the quality was very good. This thinking requires effective communication and problem solving skills as well as a commitment to overcome the egocentrism and the general public [3]. Being a critical thinker who can successfully through the following steps: (a) adopt a stance critical thinkers, (2) identify and avoid obstacles critical thinking, (3) identify and classify the argument, (4) evaluating resources, (5) evaluating the arguments [4].

Guide Note is the handouts prepared by the instructor serving information background and standard instructions with special points for writing the key facts, concepts, and/or the relationship during instructions. The reason why the strategy Guided Note taking used are as follows: (a) students produce records complete and accurate, (b) GN improve the link is active between students and subject content, (c) the students can more easily identify the most important information, (d) students are more interested to ask the instructor, (e) students test and quiz scores higher using Guide Note, and (f) the contents of the notes can be easily converted into exam. The purpose of making a record of guided learning strategy is for informed discussion method developed by teachers to get students' attention, especially in classes that the number of students is quite a lot [5].Therefore, researcher uses direct instruction model with guide note taking strategy to see if the strategy has effect toward students’ critical thinking skill in SMA Negeri 7 Banjarmasin on dynamic fluid subject matter.

II. Research Method

This research using quasi experimental research design by using two groups which are experiment group and controlled group. Research strategy is quasi experimental strategy with nonequivalent group pretest-posttest design. The research was held in SMA Negeri Banjarmasin in April 2015 for 6 learning hours or 3 meetings, with the population of the whole students of class XI SMA Negeri 7 Banjarmasin and the samples are class XI MIA 2 and XI MIA 3.

In this research, the manipulated variable is guide note taking strategy, response variable is students' critical thinking skill, and controlled variables are subject teacher, test instrument, and the subject matter. The used instrument for collecting data in this research is critical thinking skill observation sheet which is seen from students' working sheet and pretest posttest questions.

III. Result and Discussion

A. Students' Critical Thinking Skill

The observation of students' critical thinking skill aims to observe the implementation of students' critical thinking skill which is observed through students' working sheet. The observation result of students' critical thinking skill can be seen on the following table.

Table 1. Result of Students' Critical Thinking Skill

No	Observed skill	Controlled class	Experiment class
A	Identify problem	73.84 %	78.49 %
B	Determine hypothesis	72.30 %	83.41 %
C	Collect related data	82.12 %	83.75 %
D	Analyze data	78.14 %	79.07 %
E	Evaluate data	75.00 %	76.55 %
F	Make conclusion	62.75 %	79.95 %
Mean		74.02 %	80.20 %

The percentage of students' critical thinking skill implementation per aspect shows that on experiment class, the implementation percentage per aspect is larger than controlled class, it is seen from the mean value of students' critical thinking skill implementation for all aspects with the average percentage for experiment class is 80.20% and controlled class is 74.02%. The observation result of students' critical thinking skill can be pictured in the graphic below.

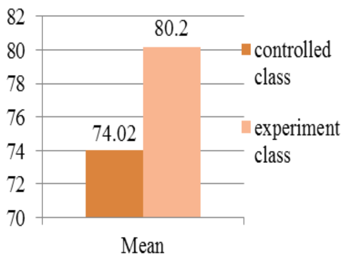

Figure 1. Graphic of Students' Critical Thinking Skill

The graphic beside shows a very significant improvement on expe-riment class compared to controlled class. It means that the students of class XI MIA 3 as the experiment class who use guide note taking strategy have higher critical thinking skill than the students of class XI MIA 2 who do not use the strategy.

B. The usage of Guide Note Taking Learning Strategy

The score of guide note taking strategy usage is gained from the resulted data in the research, which is N-gain score or guide note taking strategy effectiveness score in direct instruction model seen from the improvement of students' posttest scores compared to students' pretest scores. N-gain score for both classes as Table 2.

Table 2. Result of N-Gain Score

	Controlled class	**Experiment class**
N-gain	0.39	0.61
criteria	Effective	Effective

N-gain score also can be seen from the following graphic. From the graphic beside, it can be seen that both classes have significant improvement so the learning process is effective. Although both classes, class with and without treatment, are classified as effective, the experiment class gains higher N-gain score than controlled class, it shows that the effectiveness of learning in experiment class that uses guide note taking strategy is more effective compared to the one without using guide note taking strategy.

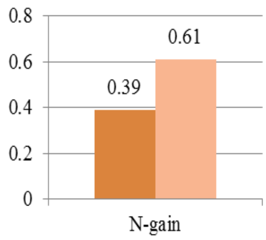

Figure 2. Graphic of N-Gain Score

C. Hypothesis Test

Hypothesis test that is used is t-test polled variant test and r-test. For t-test, hypothesis in this research is:

H_0 : There is no difference between the class that uses guide note taking strategy in direct instruction learning model and the class that uses direct instruction learning model without any strategy.

H_a : There is a difference between the class that uses guide note taking strategy in direct instruction learning model and the class that uses direct instruction learning model without any strategy.

Whilst the used data is N-gain score data of students' critical thinking skill test between experiment class and controlled class gained from posttest result. The result of t-test calculation can be seen on the table 3.

Table 3. Result of T-Test Difference Class

$t_{calculated}$ **score**	t_{Table} **score**	**Conclusion**
5.37	1.67	H_0 is rejected

From the table above, as the rule says that if $t_{calculated}$ score is smaller or equals to t_{Table} score, then H_0 is accepted. In fact, the calculation result shows that $t_{calculated} \geq t_{table}$, so H_0 is rejected. In other words, there is a difference between the class that uses guide note taking strategy in direct instruction learning model and the class that uses direct instruction learning model without any strategy.

While for r test or correlation test between both classes, uses the following hypothesis.

H_0 : There is no effect of guide note taking strategy in direct instruction learning model toward the students' critical thinking skill

H_a : There is an effect of guide note taking strategy in direct instruction learning model toward the students' critical thinking skill

Whilst the used data is students' critical thinking skill result data as the effect of guide note taking strategy usage gained from posttest result as the variable (*x*) and students' critical thinking skill data from working sheet observation as the variable (*y*). The calculation result of correlation test is on Table 4.

Table 4. Result of T-test of Guide Note Taking Strategy

$r_{calculated}$ **score**	r_{Table} **score**	**Conclusion**
0.97	0.34	H_0 is rejected

From the table, we can see that the correlation (r) between guide note taking strategy and students' critical thinking skill is 0.97, with the r score shows a very strong correlation between the two variables, the r score is positive means that there is a positive effect of guide note taking strategy and the students' critical thinking skill. The $r_{calculated}$ is larger than r_{table} means that H_0 is rejected. Therefore, there is an effect of guide note taking strategy in direct instruction learning model toward the students' critical thinking skill with the correlation of 0.97.

Table 5.Strength Points of Using Guide Note Taking in Learning

According to Cottrell	**Strength points of *guide note taking***
Critical thinking skill is considered as good if: 1. Attention and observation is improved,	1. Keep the students' attention in learning process,
2. More focus in reading,	2. Improve the students' accuracy and efficiency ,
3. Ability to identify the important point in a text or other writings is improved.	3. Students can easily identify the most important information.

It is supported by the opinion of [6] which if it is compared to some strength points of using guide note taking in learning process, so we get the comparison as the Table 4. Critical thinking skill is marked by improved attention and observation; it is supported by guide note taking strategy because this strategy can keep the students' attention focus on the learning process. Then on the second point, students are more focus in reading, in this case, students' focus can help them improve their accuracy and efficiency in taking note, and the last is students are able to identify the important points in a text or writing which can be trained by using guide note taking strategy because this strategy can make the students identify the most important points easier. Other than that, the guide note that is used in this research is arranged according to the critical thinking skill indicators and students are trained to identify the important points, identify problems, make hypothesis, evaluate data, make conclusion, and give a reason to support the conclusion, so that the usage of guide note affects the students' critical thinking skill, which is also supported by the research result.

IV. Conclusion

The invention gained from this research is that the critical thinking skill implementation percentage in experiment class is increased more significantly compared to controlled class and the n-gain value of experiment class pretest posttest is larger than the controlled class.

According to the invention above, so it can be concluded that the usage of guide note taking learning strategy affects positively toward the students' critical thinking skill in SMA Negeri 7 Banjarmasin in Physics subject, especially dynamic fluid subject matter.

Acknowledgment

All praise and gratitude to Allah SWT researchers, because thanks to His grace and guidance I can finish the study. On this occasion the researchers thank to SMAN 7 Banjarmasin which has contributed a lot in research both in research licensing, giving feedback, and cooperation in data collection for the study. Thank you also do not forget to be delivered to all parties who contributed to the smooth running of this research that can not be enumerated.

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Video-based Instruction for Video Analysing Process of Physics Experement

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Abstract**—** This paper presents the development of a practical learning video and the applicability of their usage in analysing the recorded video of linear and circular motion experiment. Ten videos have been developed and tested on 80 undergraduate students took mechanic subject and 27 physics teachers. Four constructs are used to measure the applicability of learning video. This study showed a Cronbach Alpha of 0.94. This developed learning videos are successfully in assisting students to analyse the recorded video experiments.

Keywords: *video analysis, physics, freeware, physics experiment*

I. INTRODUCTION

Video has been used as a learning tool for a long time [1]. According to Santagata et al, [2] the use of video in learning can help to increase knowledge by seeing repeatedly incomprehensible thing. Video distribution to small parts also facilitate the learning process [3]. Video are used to teach skills [4] and used as a reference [5] which can connect theory and practice.

Mixed method learning that know as blended learning is a choice at present [6], is aided by the use of the internet and its implementation easier. Usmeldi mention that [7], learning is a method of conveying information from teacher to student. The traditional method requires students face to face with the teacher, the delivery method from one to many students [8]. With the help of internet and video technologies such as the method of information delivery is becoming more widespread, and could know the method to study [9]. Income interesting videos can be one additional tools to learning [6], this will make students have many options to get the information [7]. According to research conducted by P. Lian Kee and L. Adeline, [10], Generation Y students are learning more adventurous with strategic thinking and love handle complex situations. All this can be done when a lot of training that involves creativity and higher-order thinking in providing to students. Learning to use the video to make the learning environment more motivated and help students learn through technology [11].

Using video in learning will face a problem when all information is controlled by production [12]. This will lead to an emphasis on the appeal of video can be more important than the content. In fact, some students say the subjects of physics is difficult because of the need to use a model that cannot be explained in the real world [13]. The use of video as a means of delivering information should have clear objectives for each content [5] video to be delivered. The involvement of academics will help provide objective and appropriate content in video learning. Therefore, the use of video development Tracker software has involved many people who were skilled in handling the software. To produce a short video and focus on the desired objectives, the students easier to learn.

II. RESEARCH METHOD

A. *DEVELOPMENT*

Learning video are produce using Screencast-O-Matic software from https://screencast-o-matic.com website. This software is used to record the resulting displays on the computer screen to make a short videos. After recording videos, the next process are editing using Corel Video Studio Pro X7 software. The flow of process to creating learning video as shown in Figure 1.

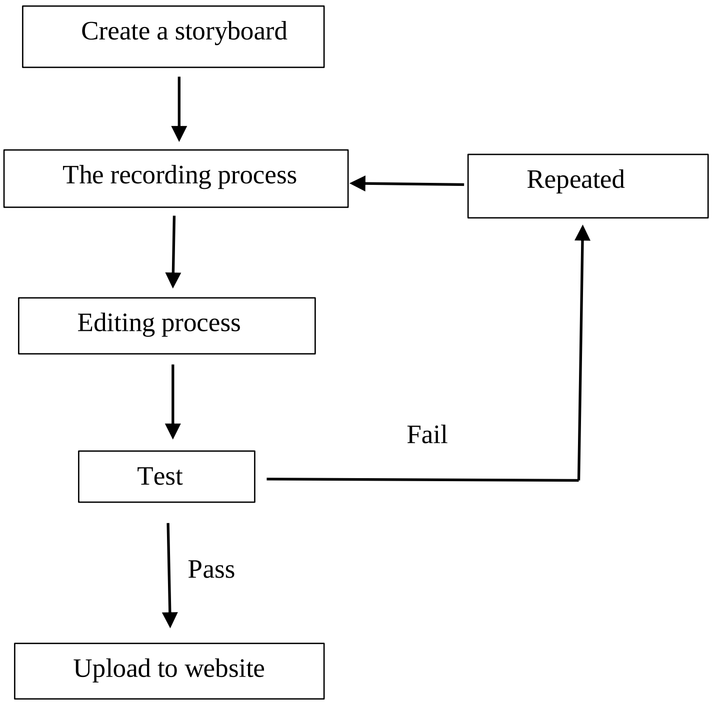

Figure 1: The flow of process to creating learning video.

There are 10 videos produced for the learning guide for the practical physics analysis software. Each of the resulting video has a duration of 1 minute to 2 minutes. This will make it easier for students to playback when necessary. The resulting video is the basic steps for using the Tracker software.

All the videos that have been developed are upload to the YouTube website and connect to the Phykir website (phykir.upsi.edu.my) as shown in Figure 2. This is to make easer for students to achieve each video. Training videos (video 11) which included a video together to produce video learning.

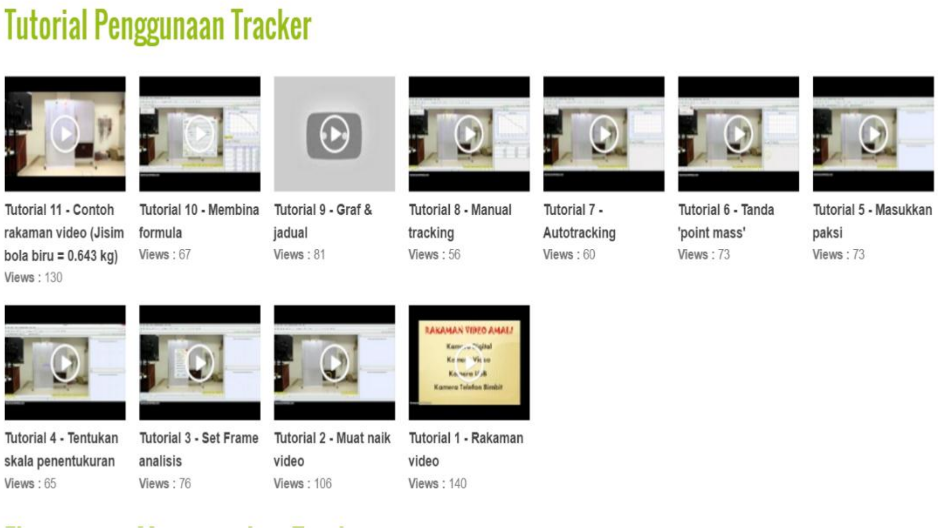

Figure 2: The view tutorials video on the Phykir website.

According to the learning pyramid, 75% comprehension will be obtained when doing what they have learned [14]. Thus while watching video instruction students are required to do the exercises while watching. This will make them understand the procedure using Tracker software.

B. *RESEARCH PROCEDURE*

Tests using 80 undergraduates who had taken physics mechanics and 27 teachers of physics. Respondents are required to watch video learning while doing exercises using the supplied video example. When faced with the problem of respondents can repeat it so skilfully. The learning period is one hour before the respondent is given a second video for training. After skilfully use the software then they will be allowed to practice provided. Figure 3 shows the flow of the learning process using the video made by the respondent.

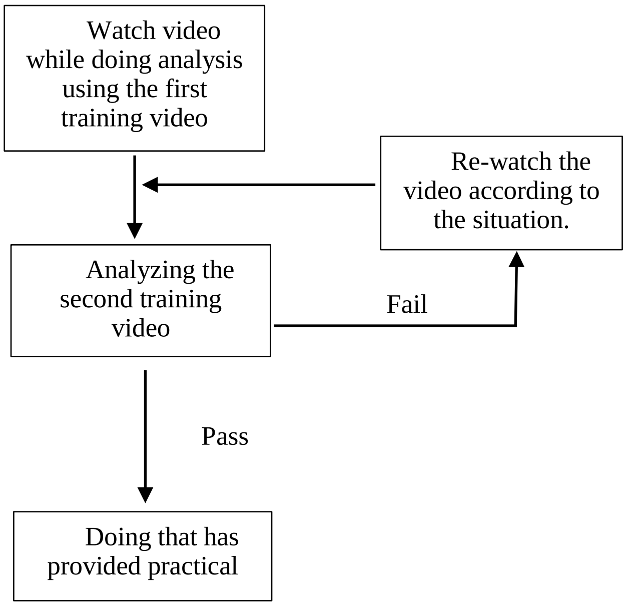

Figure 3: The flow of learning process.

C. *DATA ANALYSIS*

After learning process using video students are given a set of questionnaires. There are four part of questions that measured the dimensions of teaching and learning, motivation, design and technical aspects the results were analyzed using SPSS version 22.0.

III. RESULT AND DISCUSSION

Instructional video usability is measured by the four dimensions of teaching and learning, motivation, design and technical aspects. Results for the dimensions of teaching and learning acquired are as Table 1. The average for each item in the dimensions of teaching and learning the value of 3.0 to 3.8. That is a positive indication for the respondent to teaching and learning methods.

Table 1: Respondents Rating Based on Teaching and Learning

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No	Item	ATS (%)	TS (%)	S (%)	AS (%)	Min
1	Video tutorial ini membantu saya memahami cara mengoperasi *Tracker.*	0.0	0.0	10.0	0.0	3.0
2	Video tutorial ini membantu saya memahami teknik asas menggunakan *Tracker.*	0.0	0.0	50.0	50.0	3.5
3	Saya digalakkan untuk berfikir lebih kreatif apabila belajar menggunakan video tutorial ini.	0.0	0.0	50.0	50.0	3.5
4	Saya digalakkan untuk berfikir dan mengenang kembali apabila belajar menggunakan video tutorial ini.	0.0	0.0	25.0	75.0	3.8
5	Saya boleh berhenti dan memulakan semula ditempat yang saya berhenti apabila belajar menggunakan video tutorial ini.	0.0	0.0	25.0	75.0	3.8
6	Saya boleh mengubah kadar persembahan (kecepatan) video tutorial apabila belajar menggunakan video tutorial ini.	0.0	0.0	50.0	50.0	3.5
7	Saya boleh ke depan dan ke belakang bila perlu apabila belajar menggunakan video tutorial ini.	0.0	0.0	50.0	50.0	3.5
8	Penyampaian dalam video tutorial adalah tersusun rapi..	0.0	0.0	25.0	25.0	3.8
9	Penyampaian dalam video tutorial menarik minat saya untuk mempelajari aplikasi Tracker.	0.0	0.0	25.0	75.0	3.8

Table 2 shows the results for motivation dimension, the average value obtained is between 3.0 to 3.8. Dimension also gives an indication of positive motivation, the average value of the item to the highest value of 3.8.

Table 2: Respondents Rating Based on Motivation

No	Item	ATS (%)	TS (%)	S (%)	AS (%)	Min
1	Saya berasa seronok belajar menggunakan video tutorial ini.	0.0	0.0	50.0	50.0	3.5
2	Saya gembira sekiranya aplikasi lain juga ada video tutorial sebegini.	0.0	0.0	25.0	75.0	3.8
3	Pembelajaran melalui video tutorial ini menambahkan minat saya untuk menggunakan aplikasi Tracker	0.0	0.0	50.0	50.0	3.5
4	Dengan adanya video tutorial ini saya lebih berminat untuk menggunakan aplikasi Tracker berbanding aplikasi lain..	0.0	30.0	20.0	50.0	3.0
5	Saya yakin dapat menguasai kemahiran menggunakan aplikasi Tracker melalui video tutorial ini.	0.0	0.0	50.0	50.0	3.5
6	Saya yakin dapat memahami kandungan yang disampaikan di dalam video tutorial.	0.0	0.0	10.0	0.0	3.0

Dimensional design for the average value between 2.3 to 3.8 as shown in Table 3. The average value of a low of 2.3 for related items affecting voice clarity. The improvement of the sound quality of the video needs to be done.

Table 3: Respondents Evaluation Based on Design

No	Item	ATS (%)	TS (%)	S (%)	AS (%)	Min
1	Video tutorial ini menggunakan warna latar belakang yang bersesuaian.	0.0	0.0	25.0	75.0	3.8
2	Suara yang digunakan dalam video tutorial dapat didengar dengan jelas dan tepat.	25.0	25.0	50.0	0.0	2.3
3	Saya gemar dengan susun atur video tutorial.	0.0	0.0	25.0	75.0	3.8
4	Saya gemar dengan teknik penyampaian yang diberikan dalam video tutorial.	0.0	0.0	500	50.0	3.5
5	Saya mudah memahami bahasa penyampaian di dalam video tutorial	0.0	0.0	25.0	75.0	3.8

Due to the use of video technology and technical dimensions also made a one-dimensional measurement of usability video. The average value obtained is between 2.8 to 3.8. The average low for the first item of technical problems to play video tutorial. This is because computers did not have the appropriate video player.

Table 4: Respondents Evaluation Based on Technical Aspects

No	Item	ATS (%)	TS (%)	S (%)	AS (%)	Min
1	Saya tidak menghadapi masalah teknikal dalam memainkan video tutorial.	0.0	25.0	75.0	0.0	2.8
2	Video tutorial berfungsi dengan baik dalam komputer saya.	0.0	0.0	25.0	75.0	3.8
3	Video tutorial mudah dimainkan dalam komputer saya.	0.0	0.0	50.0	50.0	3.5

IV. CONCLUSION AND SUGGESTION

Overall video learning Tracker can be used by the respondent to use the Tracker software. Technical problems can be resolved after the respondents entered the computer software to read video. While for troubleshooting voice responder can use headphones for more details. In the future construction of the video must consider software that can be used to play video and sound recorded strong need clearer tons.

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PE – 09

DEVELOPMENT OF WEBSITE "MEASURING INSTRUMENT" THROUGH BLENDED LEARNING

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Abstract—This study aims to determine the feasibility of web-based instructional materials in material measuring instrument that is developed for blended learning. The method used is a Research and Development (R & D). It is a method used to produce and test the effectiveness of the product. Adapt the model development procedure Thiagarajan 4D. The instruments are used in this research is questionnaire for the expert and teachers. The results showed that the product website measurement tool material is very good quality expressed by the validator matter experts and teachers. Students XB light vehicle expertise SMK Diponegoro also responded very well to the website.

Keywords: *Learning materials website, blended learning, measuring instrument.*

I. INTRODUCTION

Education is a conscious effort to develop the potential of human resources through teaching activities. Learning is a process that is done a lecturer and students through experience, given the control of the experience and get the information. To implement the learning process, teachers need to expand their knowledge and skills were adequate according to the demands of the times and the advancement of science and technology.

National Education serves to develop and form the character and civilization of the nation's dignity in the context of educating the nation (UU RI No.20 of 2003 on National Education System). To develop and form the character and civilization of the nation's dignity, education serves to develop the entire potential of learners "become a man of faith and devoted to God Almighty, noble, healthy, knowledgeable, skilled, creative, independent, and become citizens of a democratic and responsible "(UU RI No 20 of 2003 on National Education System).

To realize the objectives of the national education, vocational schools (SMK) is an avenue for participants oriented that after graduating soon or easy to get a job in accordance with the disciplines or skills they have (eg in the field of technical drawing). The learning process as a system, in principle, an inseparable unity between the components: raw input (input raw: learners), the instrument input (feedback instrumental), environment, and the output of its. The fourth component is realized with the process of learning the system is at the center. Instrumental input component, in the form of curriculum, teachers, learning resources, media, methods and infrastructure of learning, seem to greatly affect the learning process. In modern theory, the learning process does not depend at all on the presence of teachers (educators) as the manager of the learning process. It is based on that learning is essentially an interaction between learners with the object being studied.

Learning outcomes are the result of a learning activity. Learning outcomes are a result of the teaching-learning process that reflects the students' abilities to meet their learning experiences in basic competencies and is an indicator of the value of the use of learning strategies. According to Bloom's taxonomy (Anderson and Krathwohl, 2001), learning outcomes are divided into three areas, namely cognitive, affective, and psycho motor. The results of cognitive learning is divided into six levels, namely remember , understand, apply, analyze, evaluate, and create.

Therefore, the need for an action to resolve the issue, one of them by providing a media that can help students achieve cognitive competencies of measuring devices that have been defined before. According to Helmut Nolker and E. Schoenfeldt (1983: 35), media in this context is a means of delivering information that must be absorbed by the study. Instructional media or materials are such that the material or essential information in a discussion of the material can be absorbed by the students in this are the students.

The passage of the curriculum implementation in 2013, one of the successful implementation of the curriculum in 2013 educators demanded an active role in creating that focus on student activities, teacher as facilitator. Based on a survey in SMK Diponegoro Depok in Sleman, Yogyakarta, many teachers do not discharge the obligations that focuses on student learning or student activities, learning is still dominated by the teacher or conventional learning. Limitations of the practice facilities, especially in the measuring tools and conventional learning students have not give more chance to students for get experiences of learning. Students cannot achieve maximum competencies of cognitive, affective and sensory motor. As students' achievement goals in 2013. The development of ICT in the curriculum SMK cannot be use optimal by teacher in innovative instructional. One of the efforts of integrating ICT in learning in vocational namely through e-learning.

E-learning system can be implemented in the form of asynchronous, synchronous, or a mixture of both. Examples of asynchronous e-learning often found on the internet either simple or integrated through e-learning portal. While in the synchronous e-learning, teachers and students must be in front of a computer together because the learning process carried live, either through video or audio conferencing. Hereinafter known as the term blended learning ie learning that combines all forms of learning, for example on-live, live, as well as face-to-face or conventional (Herman Dwi Surjono, 2012). Learning through learning-based website is also an E-learning is an abbreviation of Electronic Learning, a new way of teaching and learning using electronic media, especially the Internet as a learning system.

There are many advantage using e-learning. According to Yunus Madao Ferries (2008: 1), the advantages of using e-learning include: (1) save your time learning process; (2) reduce travel costs; (3) reduce the cost of education as a whole (infrastructure, equipment, books); (4) reaching a wider geographic area; (5) train students more independent in getting science knowledge.

In this research, the instructional will using e-learning system through blended learning system. Blended learning brings together the most useful of both the traditional classroom and digital learning environments in the context of a specific educational setting (Rovai and Jordan 2004). The traditional classroom is limited in time, location, materials use and peer contact. Digital learning environments lack such limits to a great extent and this allows for an optimisation of conditions of learning on an individual level. The introduction of a digital learning module in a learning process entails more freedom, more control and more responsibility for the student since it allows the learner to decide what learning approach to take, how to use the digital educational material or how much time to invest. Such a learning environment encourages learners to discover and develop the personal relevance of the knowledge they acquire and stimulates them to adopt a more active learning attitude. With that kind of potential impact on the unfolding of each learner’s individual way of acquiring knowledge, blended learning can be seen as a truly holistic approach to education (Singh, 2003).

At this time measuring instrument is an important tool in the machining process from start to manufacture with quality control in the production end. Without measuring tools, machine elements can not be made sufficiently accurate to be able to exchange (interchangeable). At the time of assembling, which assembled components must fit each other. Therefore, the mastery of concepts and skills of the measuring instrument is very important. During this time, learning to material presented verbally measuring instrument with the help of make shift media measurement tool in real form. Limitations that happens is the teacher had trouble encounters an object with all students in the class individually, and sometimes essential matters that must be mastered students can not be conveyed properly. Certainly, the issue must be addressed with the support of a quality digital teaching materials and students can help teachers teach optimally in mastery of the material and the skill of the measuring instrument.

Based on the many studies on the use of ICT in learning contributes greatly to student learning outcomes.Buket A & Meryem Y : Results showed that the students enjoyed taking part in the blended learning environment. Students’ achievement levels and their frequency of participation to forum affected their views about blended learning environment. Face-to-face interaction in blended learning application had the highest score. This result demonstrated the importance of interaction and communication for the success of on-line learning

The development of ICT in vocational boarding school haven’t use by teacher of SMK Diponegoro as a supported instructional in the interactive and innovative learning. Additionally, student achievement in subjects Using Measure Tool is also not optimal. Based on the problems of learning in vocational boarding school Diponegoro, it is necessary to research on the development of the website material measuring tools through learning blended learning to improve student achievement class X SMK Pondok Pesantren Diponegoro Yogyakarta Sleman. A web-based teaching materials as well as a learning medium in which the media have a strategic role in the achievement of student competency. Schramm (1977) suggested that learning media is the messenger technology that can be used for learning objectives.

II. RESEARCH METHOD

The website development research in the Research and Development (R & D). The research model of development used is the 4-D Model. The model was developed by the 4-D model of the development consists of four main stages, namely: (1) Define (definition); (2) Design (design); (3) Develop; (4) Disseminate. The research instrument used is to test the feasibility questionnaire website e-learning by media expert, material and of the students. The population in this study were all students of SMK Diponegoro Depok, Sleman, Yogayakarrta. The sample in this study is one class is class XB XA TKR whereas for class Test product. The sampling technique that is purposive sampling, taking into account the acquisition of student achievement in subjects Using the Measure Tool.

The activities carried out in stages as follows Define are:
1. Identify the basic competencies and learning outcomes in learning Using Measure Tool SMK.
2. Identify the characteristics of students in SMK Diponegoro Depok, Sleman Yogyakarta.
3. Identify the initial ability of students, teachers, and school environment of activities related to teaching will be selected.
4. Identify and evaluate the learning device that already exist.

The activities carried out in the following phase Design are:
1. Designing and drafting a learning tool for some basic competency (in one semester).
2. Determine the type of the relevant assessment / need analyses.
3. Determine the test procedure validation and learning devices.

The activities carried out in stages as follows Develop are:
1. Perform validation by gathering input from experts, teachers, and students. Validation is done through internal review, external review, limited test.
2. Revise the teaching materials which has been given the feedback from experts, teachers, and students.
3. Tested a prototype device based learning website E-learning in class to obtain a students' response.
4. Revising the finalization of learning software products.

The activities carried out in stages Disseminate as follows.
1. Make revisions after learning device tested on a limited basis.
2. Socialize and disseminate the results of development and testing tools the e-learning website.

Data were collected by questionnaire for data product validation and product feasibility webite achievement data obtained with cognitive testing and assessment sheets current performance practice. Furthermore, the data obtained were analyzed descriptively.

III. RESULTS AND DISCUSSION

3. Research on the Define phase is obtained from the initial analysis, the analysis of the students, the task analysis, concept analysis, and analysis of learning objectives. Results of a preliminary analysis is based on the observation during these teachers are not using wifi facilities in schools with optimal learning. In addition, teachers are still dominated learning so that students tend to be passive. It certainly needs to be addressed so that school facilities can be used optimally for learning materials measuring instrument and learning that takes place can be student centered. At this stage also conducted task analysis is to identify the basic competencies contained in the standard course content related to the Measure Tool Using Basic Competence selected are: "Using precision measuring equipment Element / measurement objects". After the identification of basic competencies, then do analysis of the concept. The concept that can be learned by students is a mechanical measuring instrument, the measurement results. Based on the task analysis and the analysis of the concept, the next step is to analyze the learning objectives. The purpose of learning is to be achieved by learning Measurement "measure with calipers" Through the medium of e-learning website and lectures are as follows:

1. Students can identify kinds of mechanical measurement instrument.

2. Students can model the mechanical function of the measuring instrument.
3. Students can use carefully and correctly on the each measuring instruments in accordance with the type and the function.

After the Define phase is completed, the next step is the Design phase. At this stage the results obtained include: (1) the selection of media and (2) the selection of formats. The results of the election media that the teaching materials will be developed to deliver the material in the form of website material measuring tools. Having website chosen for instructional media, the next step is to determine the format of the website that will be used. As for the format or the basic framework include: (1) Title chapters / sections: Tools mechanical measurement (vernier caliper and micrometer); (2) The components of a complete materials such as introduction, description and cover; (3) aspects of learning that includes competence, material, product usage instructions, evaluation.

Presentation of the steps blended learning combining face to face classroom learning and computer assisted learning. Students are given the opportunity to use the website in the study material independently measuring instrument. Before learning begins held in written pretest to determine the initial achievement of students in learning. Furthermore, students are given the direction of learning activities that will be done and also given the opportunity to open a website link material measuring tools namely: www.smkdiponegoro.com After learning, the students are asked to do posttest in writing and provide a response to the website is used. Expected to blended learning, the learning can take place more effectively and efficiently.

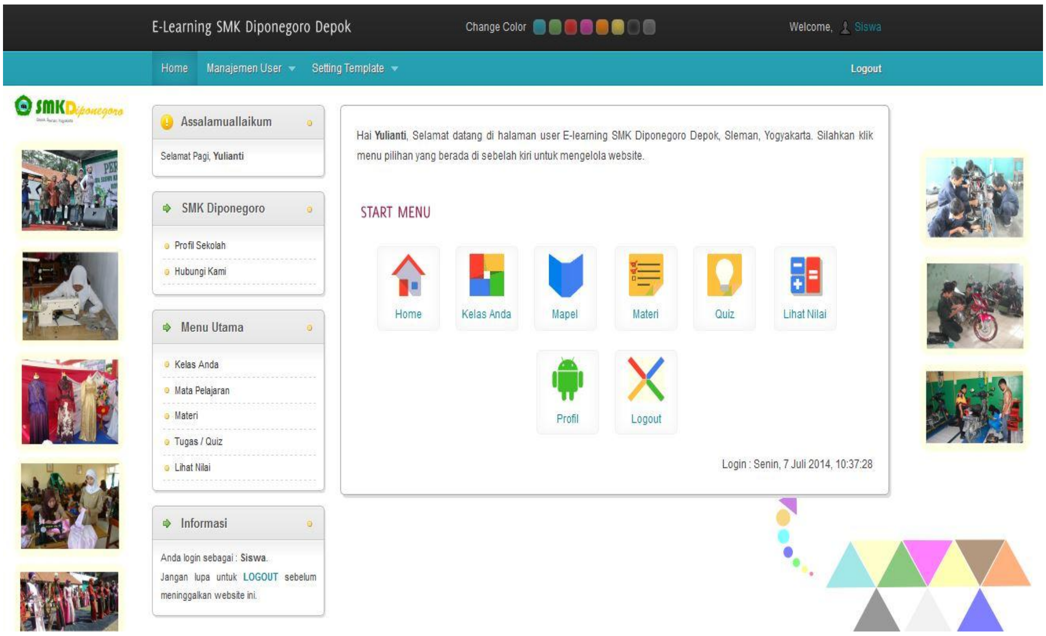

FIGURE 1. THE VIEW OF WEBSITE E-LEARNING

SMK DIPONEGORO DEPOK, SLEMAN, YOGYAKARTA

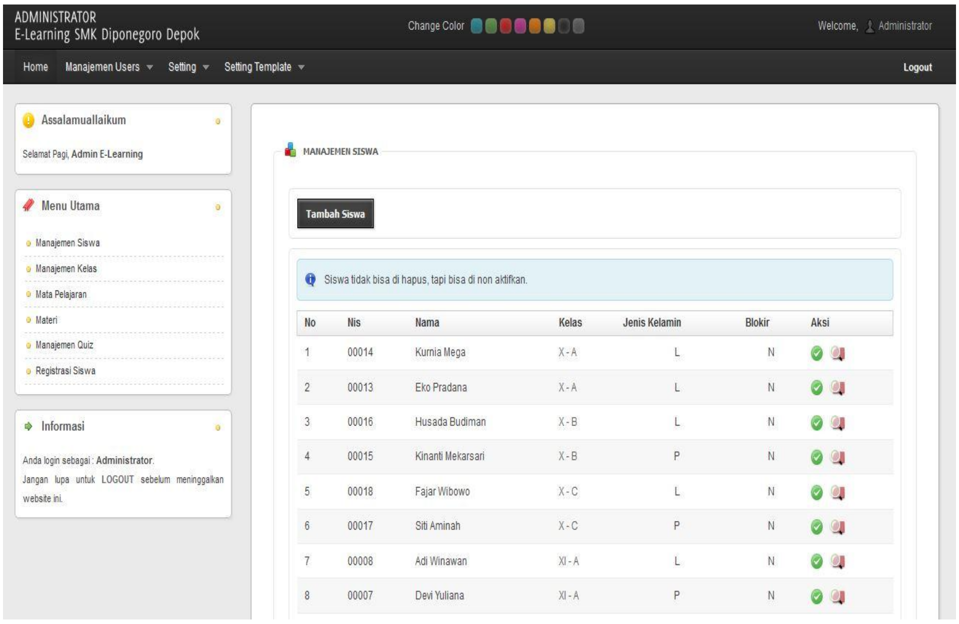

FIGURE 2. THE VIEW OF STUDENTS' ADMINISTRATOR IN SMK DIPONEGORO'S WEBSITE

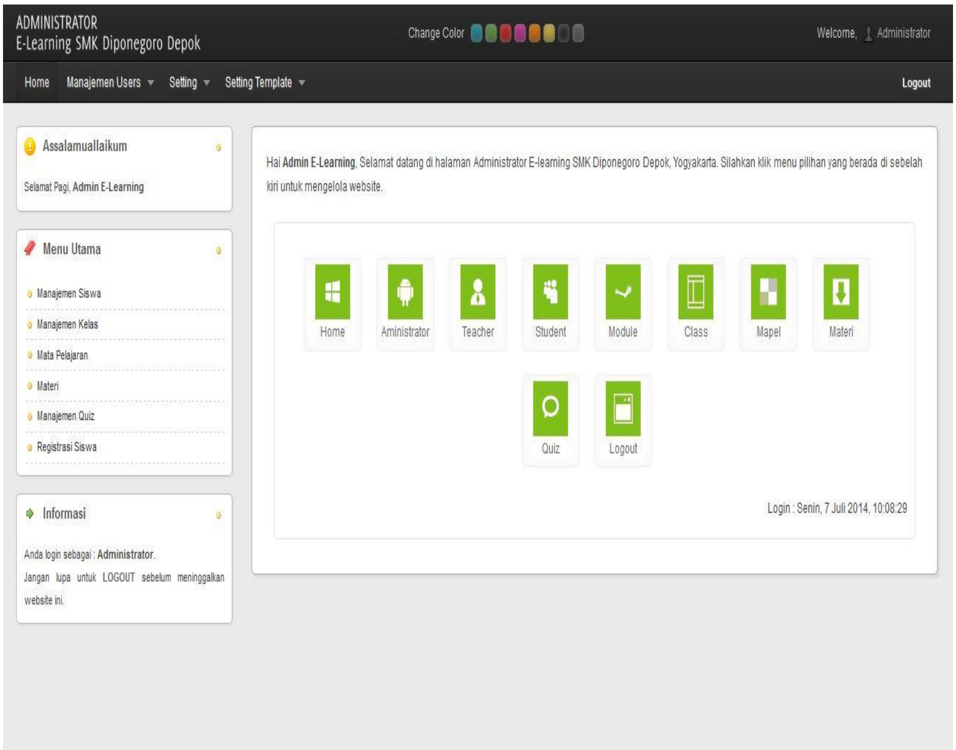

FIGURE 3. THE VIEW OF WEBSITE'S MENU

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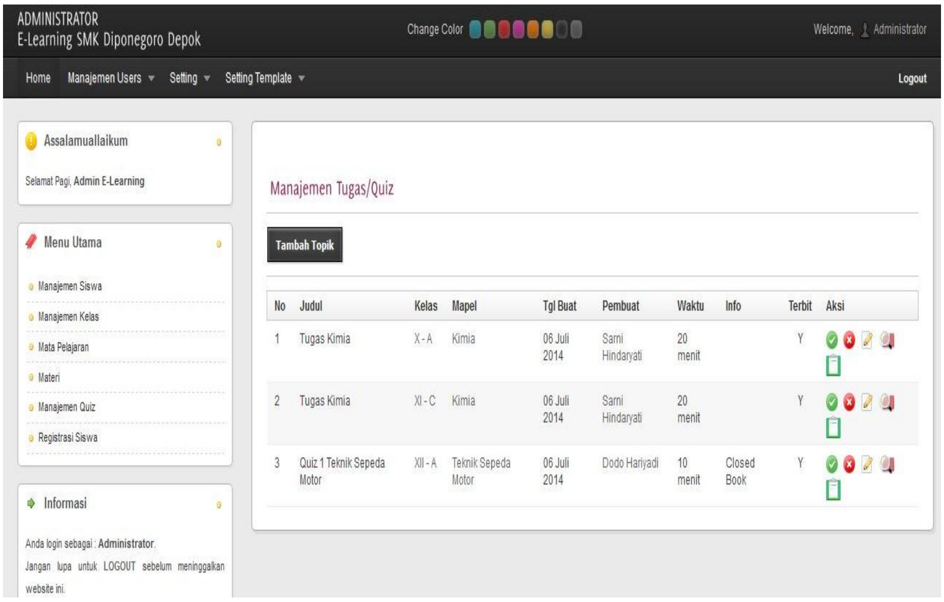

FIGURE 4. THE VIEW OF WEBSITE'S ASSIGNMENT MANAGEMENT

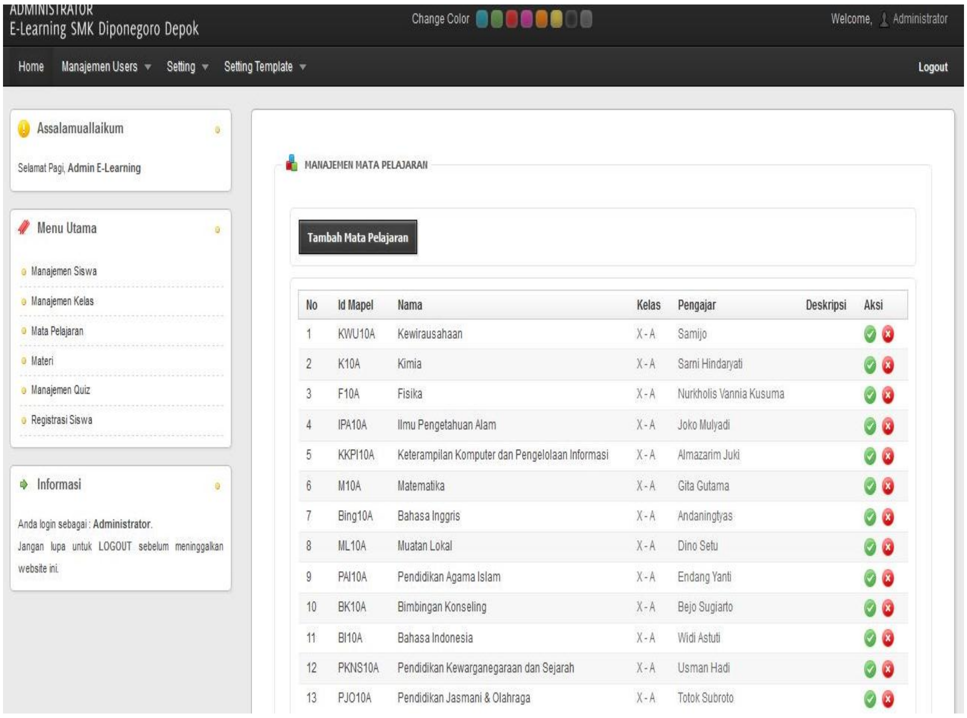

FIGURE 5. MANAGEMENT OF SUBJECT MATTER

The third stage is the stage of develop. The results of this phase in the form of validation reviewers and test websites. Reviewers validation carried out gradually, starting from the material and media experts, teachers of subjects Using Measurement Tools, and thirty-three students of SMK Diponegoro. Draft I validated the two subject matter and media expert. The subject matter expert evaluate the product from the aspect of truth of the material presented in the website material measuring tools, while media expert judging from the aspect of quality of content, and language display quality, interaction quality, and quality software engineering. Based on the results of the questionnaire filling materials experts, data showed that all of the concepts presented are correct, but need ditambahan to illustrate the concept that learned. Media experts provide an assessment that the quality of products in terms of four aspects assessed were excellent. The assessment results as in Table 1.

TABLE 1. PRODUCT RATINGS BY MEDIA EXPERT

No	Aspect of assessment	Expert Media	Category
1	Feasibility Content and Presentation component	3, 14	Very Good
2	Language and Figure components	3,25	Very Good
3	Performance component	3,17	Very Good
4	Graphic component	3,23	Very Good

The suggestion given by the media expert are: to increase the attractiveness of the display, to make completeness pictures to help understanding of the concept, to show practice simulations use measuring devices more systematically, and to use of language more effective and efficient. Those are acted upon as a product improvement. The results of these evaluations I made revisions to a draft so that the products I tested and ready to students in the learning Using Measure Tool.

Product also validated by measuring instrument teacher at SMK Diponegoro. Based on teacher ratings were obtained suggestions to improve the four aspects of the feasibility of the content, appearance and language, performance, and graph. Repairs carried out by acting upon the feedback received from the teacher due to the onstructive criticism and suggestions for improvement of the website. The evaluation results will serve as a revision II so that the product to a draft II and ready to be tested.

Draft II tested to thirty-three students class XB expertise light vehicle test is done to determine the students' respons to the website and learning systems that have been developed. After the test phase, obtained the advice and input from the student to the website can be used as a further improvement. The feedback given is related manuals, quizzes or practice and display their quiz results or training of students online. After revision II, then the end product is produced in the form of website material Measurement Tools, here in after referred to as the final product.

IV. CONCLUSION

Based on the results and the discussion above it can be concluded that the website material that researchers have developed a measuring tool has met these criteria and can be declared eligible to be used as teaching materials. Based on the all these aspect analysis that includes an analysis of the product indicated through a questionnaire, it can be said that the website material Measurement Tools for blended learning model developed decent used as teaching materials in learning Using Measure Tool.

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PE – 10

Guided Inquiry Learning Using Virtual Laboratory To The Mastery Of The Concepts Of Physics

A Preliminary Study

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Abstract**—** There are many hindrances for one to reach the mastery of concepts in physics learning. Guided Inquiry learning in physics is closely associated with experimental laboratory since physicians discover physics through experiments. This study aimed to describe the learning of physics. The study conducted in State Vocational High School 1 Panji, Situbondo in which took randomly 15 Year-10 students as the samples to determine their responses toward their teachers' learning method. The data is collected by interviewing. An interview with a physics teacher in the school was conducted utilizing the interview instrument which had been prepared by the researchers. The results show that the school could provide neither the experimental equipments nor the physics laboratory to aid students to understand the concepts of physics. The lack of both experimental instruments and physics laboratory in the school impacted on students' average performance in physics final semester examination which could only reach the score 65.82 out of the maximum score of 100. Moreover, based on the interviews with the students, the absence of the physics laboratory in the school made them felt that physics learning materials are abstract and could not scientifically proven its validity by experiments. Those assumptions made students experienced the difficulties to understand physics concepts. Based on the interviews, the researcher felt that it was appropriate to propose Guided Inquiry learning using virtual laboratory to substitute physics laboratory in improving students' learning outcome.

Keywords**:** *Guided Inquiry, mastery of concepts, virtual laboratory*

I. INTRODUCTION

Physics as a part of science investigate the natural phenomena that occur in the surrounding. The truth of physics can be reflected on the truth of science. Pay attention to these definitions of science: science is a problem solving activity conducted by humans who are motivated by a curiosity about the world around them and a desire to understand that world, or by a desire to manipulate the world in order to satisfy other wants or needs, or by both of these [6]. Science is (1) body of knowledge (2) method (3) way of knowing, or (4) the values and beliefs inherent to scientific knowledge and its development [9]. From those definitons, it can be inferred that physics as a body of knowledge in science is packed with facts, concepts, principles, laws, and theories. Those are the scientific products of physics. Physics as a scientific process is occupied by some skills that should be applied to yield scientific products. This is known as scientific methods which are formulating the problem(s), constructing the hypothesis, conducting the experiment, collecting the data, analyzing the data, and drawing the conclusion(s). In doing the scientific process, a physician is motivated and controlled by scientific attitudes such as curious, sceptical, open-minded, honest, impartial, data-oriented, cooperative, and determined. According to that explaination, it can be implied that the essence of physics learning are: (1) Physics learning is a process which one creates a condition and opportunity to help the learners to construct their knowledge, process skills, and scientific attitude. (2) Physics learning credits students' initial knowledge. (3) Physics learning occurs when one is involved in the interraction between nature and other human being. (4) Physics learning must cover education, process, and attitude aspects all together.

Ideally, Physics learning at schools should give more emphasis on the drilling of concepts to the students [8]. However, Physics learning at schools only focuses the students to be proficient with the formulas [1]. Therefore, students are not actively encouraged to drill the concepts. Consequently, students will tend to remember the concepts in Physics [10]. A report from Trends in International Mathematics and Science Study (TIMSS) published in 2011 indicates that the Indonesian students' average score for Mathematics is in 38th place out of 42nd countries. On the other hand, the average score for Science modules is far more disenchanting, Indonesian students sit in 40th place out of 42nd countries. Most of the students can only solve Physics problems until the intermediate level. It is implied that there are differences in what are being taught in Indonesia compared to what are tested on international level. TIMSS's study confirms that Indonesian students are having very low competence in (1) understanding complex information, (2) understanding the theory, analysis and problem solving, (3) operating the instruments, procedures, and problem solving and (4) conducting investigations [11].

According to those problems, researchers predict that a change in the teaching and learning activity of Physics in Indonesia is needed. This change is aimed to improve students' curiosity and to motivate them to be more active and critical. That is why the process of Physics learning should put more emphasis on the students' active participation and the teachers' teaching innovation [2]. Physics learning is more than just a set of memorizing activities; but it can be utilized to empower students' thinking capabilities so that they are able to think analitically, inductively and deductively; master the knowledge, concepts, and principal of Physics; as well as posses the competency in scientific knowledge, skill, and attitude [10].

The researchers propose the integration of inovative learning, a learning method based on constructivism theory in which students are encouraged to take the responsibilities to construct the knowledge in their minds through a series of scientific activities whereas the teacher is utilized to facillitate. A good learning activity should rely on scientific inquiry to develop students' thinking ability, scientific work habit, and attitude, as well as to communicate them as an integral aspect of life capabilities [8]. The application of Scientific Approach into the learning activity has been emphasized as a special feature of Curriculum 2013 (current Indonesian curriculum for formal education). Scientific Approach can be utilized as a bridge for students to develop their attitude, skill, and knowledge. In an approach or working process that fulfills scientific criterias, scholars prioritize more on the inductive reasoning than the deductive reasoning [7]. The application of scientific approach in the learning activity demands a change of setting and form of learning in which is different to the conventional learning. Some methods that are in line with the principal of scientific approach are: (1) *Problem Based Learning*; (2) *Project Based Learning*; (3) Inkuiri/Inkuiri Sosial; dan (4) *Group Investigation* [8]. This models guide students to identify the problems, summarize the problems, find the solutions or test the answers by doing some investigations (finding the fact through their senses), it is hoped that they can draw conclusions and present the data in verbal and written forms.

Teachers' role as facillitators in Inquiry Based Learning model is projected when the teachers convey the problems based on the learning materials at the beginning of the learning activity, thus students ought to find the answers individually or collectively. Teachers can provide supervisions only when the students find any difficulty. This is consistent with the concept of Inquiry Based Learning which originates inscience education, where students create and test a hypothesis (or problem) and throughout the process are encouraged to become actively involved in the discovery of information by highlighting both the useful ness and the application of the information itself. Throughout this process, students discover facts and develop a higher-order understanding of topics and ideas [3]. Inquiry Based Learning starts when students summarize the problems, after concluding the hypothesis, students will actively find the information and facts (data) to solve the problems. By employing this process, students find the facts and develop those into advanced understanding.

Flick and Lederman explain some steps to do Inquiry Based Learning as follows [7]. (1) Identify the problems or questions to be answered through scientific investigation. (2) Suggest the hypothesis. (3) Design and conduct the scientific investigation. (4) Apply appropriate instruments and techniques to collect, to analyze, and to render the data. (5) Develop the description, explanation, prediction, and model using the investigation data or results. (6) Draw conclusions based on the relationship between the problems, data (facts), and explanations. (7) Communicate the investigations and its results. One example of the method in Inquiry Based Learning is experimental method. According to the aforementioned learning sequence, the application of Inquiry Based Learning needs experimental method in the investigation process [5].

This research is directed to describe the learning of Physics at schools. The study is expected to provide benefits (1) for the researchers, to determine the appropriate treatment in solving students' problems at school, and (2) for the school, to get a suggested solution to solve the problems of Physics learning in State Vocational High School 1 Panji.

II. METHODOLOGY

The study was conducted at State Vocational High School 1 Panji Situbondo. The subjects of the research are a Physics teacher and 15 Year-10 students in which were taken randomly to determine their responses toward their teachers' learning method. The data is collected by interviewing. An interview with a physics teacher in the school was conducted utilizing the interview instrument which had been prepared by the researchers. The research was conducted on November 26th 2015 and December 15th 2015.

III. RESULT AND DISCUSSION

The researchers drew on the interviews results from students and the teacher to describe Physics learning in the school as follow:

A. Interview results with the teacher of Physics

The researchers asked the Physics teacher of State Vocational High School 1 Panji 13 questions, and both the questions and responses transcribed and summarized below.

Table 1. Transcript on interview with the Physics teacher about the Physics learning activity in State Vocational High School 1 Panji

No	Questions	Teacher's responses
1	What method (s) do teacher usually use in the learning of Physics?	I make use of various methods in the Physics learning, such as: lectures, discussions, questions and answers, and assignments.
2	What are students' responses toward teacher's methods?	Students' attidudes varies from one to another, since every student in the class has different cognitive abilities. Some of them are enthusiastically following the lesson, yet the rest are acting lazily and making noises.
3	What kind of learning model that is most frequently used?	Mostly use DI model, since this kind of model does not need much time to conduct.
4	What learning medias that are usually employed in the learning activity?	The learning medias that are usually employed are whiteboard, LCD, laptop, and power point slideshows.
5	How about students in Year 10's achievement in completing the lesson nowadays?	The individual Minimum Completions Criteria (*Kriteria Ketuntasan Minimal*) for class X MM, TPHP, RPL, TKJ are 75 and for the whole class is 85%.
6	How about students' performances in Physics at the final semester examination?	Students' average grade in Physics is 65.82.
7	What problems are found during the teaching and learning activity?	The problems are: 1) Students are lack of motivation to study and look passive during the teaching and learning activity in the class, some students come late to the class, keep forgetting to do the assignments, feel unhappy, and make noises in the class. 2) The lessons which involve experiments can not be carried out in the class since the school provides neither adequate experimental instruments nor any physics laboratory. 3) Physics learning materials can not be delivered completely until the end of every semester since the students are having so many activities to do while thePhysics learning activity is only allocated 2 hours of meeting per week.
8	What kind of efforts that have been carried up to overcome those problems?	Students are always asked not to repeat their bad behaviors. However, if that still persist, a strict punishment in the form of counsel guidances will be awarded.
9	During the learning activities, do students are directed to solve the problems so that they can discover the concepts by themselves?	During the learning activity, students are hardly ever directed to use that kind of strategy, on the other hand, students are given tasks and questions to be solved. To measure their ability, some written competency examinations are given.
11	What characters do the teacher wants to establish during the teaching and learning activity?	It is hoped that the students are able to show honesty, carefulness, independence, hard work, communication in discussions, tolerance, and discipline.
12	Does the teacher ever employ any virtual laboratory mediaduring the learning activity?	There has not any history of the application of virtual laboratory mediaemployed during the learning activity.
13	Do the school provide computer laboratory?	Every department in the school has a computer laboratory, while for every students of informatics and technologydepartment, owning a portable computer is a must.

The Physics teacher in State Vocational High School 1 Panji during the classroom activity applies conventional methods to carry out the lesson for example lecture, discussion, and assignments to the students. To raise students' experience, competence, and interest in the Physics learning activity, the teacher keeps on trying to find the most appropriate learning media. Inquiry Based Learning is encouraged in science learning activity, moreover it is supported to be carried out in the learning of Physics to empower students with the concepts mastery and scientific attitude and to develop students' scientific processing skill. State Vocational High School 1 Panji can not provide any Physics laboratory at the moment which makes it difficult to deliver the lesson by conducting experiments, however students are obliged to own laptops, this fact is beneficial for them to carry out the lesson via virtual laboratory to substitute the lack of Physics laboratory. Guided Inquiry Learning using virtual laboratory is expected to help both the teacher and students in conducting Physics learning process [12].

B. Interview results with students

The researchers interviewed 15 students of State Vocational High School 1 Panji, the results are written in Table 2 below.

Table 2. The Recapitulation on Interviews with students about the learning of Physics in State Vocational High School 1 Panji

No	Questions Analysis
1	A total of 80% of students testify that the method being used in the class at the moment is answering questions and problems.
2	A total of 73% of students agree that the medias being used in the class are mostly powerpoint slideshows and whiteboard.
3	A total of 93% of students find that it is difficult for them to comprehend Physics since the subject has a lot of complex formulas to be remembered.
4	A total of 87 % of students read and memorize their notebook to overcome their problems.
5	A total of 73 % of students argue that the learning activities are rarely directed to help them solve the problems.
6	A total of 67 % of students agree that Physics is a difficult subject to learn, however they sometimes find it challenging and easy to learn when they understand.
7	Every student approves that they has never conducted any learning activity using experimental method.

According to the interviews, 100 percent of the participants agree that they have never conducted any experimental method in their learning activity. Whereas the learning of Physics should have put more emphasis on experiments since that are how physicians discover the laws of Physics. A total of 93% of students find that it is difficult for them to comprehend Physics since the subject has a lot of complex formulas to be remembered, so that an active and inovative learning environment in Physics learning is surely needed to develop students thinking capabilities. This is beneficial to help the students attain the ability to develop analitically both inductive and deductive thinking. To master the knowledge, concepts, and the principles of Physics; as well as have the scientific knowledge, skill, and attitude, Inquiry Based Learning is suggested to be applied during the teaching and learning activity of Physics in the school. As there are 73 % of the students feel that the learning activities are rarely directed to help them solve the problems, Inquiry Based Learning needs some alterations in its implementation; the supervision of the teacher is still needed, that is why Guided Inquiry Learning is deemed more appropriate. The application of Guided Inquiry Learning in the school still needs to be researched in the future, this is because the State Vocational High School 1 Panji can not provide Physics laboratory at the moment. The fact that the students are obliged to have their own laptops opens the suggestion to make use of virtual laboratory as a substitution to the absence of Physics laboratory [4].

IV. CONCLUSIONS AND SUGGESTION

Based on the study that had been conducted, it can be inferred that: (1) The teachers and students of State Vocational High School 1 Panji need a new learning model that can aid the students to comprehend the concepts and principles of Physics in which is not too complicated to be applied with Inquiry Based Learning model. This can assist the students to understand the concepts, laws, and principles of Physics. (2) The physics teacher of State Vocational High School 1 Panji has comprehended and mastered the Inquiry Based Learning model in the learning of Physics, however during the implementation; the teacher still employs Direct Learning method such as lectures, discussions, and assignments. (3) The teacher and students of State Vocational High School 1 Panji require virtual laboratory media as a substitution to the absence of Physics laboratory in the school. According to those conclusions, the researchers recommend that a follow up research on "the impact of Guided Inquiry Learning using virtual laboratory toward the mastery of the concepts of physics and the ability to work scientifically in the students of State Vocational High School 1 Panji."

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PE – 11

The Attainment Of Learning Outcomes Of Indonesian Qualification Framework Level 6 Among Physics Teachers

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***Abstract*—** This study aimed to reveal how high the attainment of learning outcomes of Indonesian Qualification Framework (IQF) Level 6 by physics teacher in SHS/ISHS/VHS who graduated from Yogyakarta State University. This research is an evaluation with qualitative and quantitative approaches. The research subjects were physics teachers in SHS/ISHS/VHS who graduated from Yogyakarta State University majoring physics education in Yogyakarta province and have not been certified. The data were collected through questionnaires, observations, interviews, and documentation. Instrument was validated in terms of content and construct by experts. Descriptive analysis was used to analyze qualitative interviews and at significant events during the observation of the learning process. Quantitative descriptive analysis was used to analyze the results of assess documentation, questionnaires, and observations by comparing the scores of the observers with the assessment criteria. The results of the study showed that 90% physics teachers at SHS/ISHS/VHS who graduated from Yogyakarta State University reached 92% learning outcomes of level 6 IQF.

Keywords: *learning outcomes, level 6 IQF, physics teacher*

I. INTRODUCTION

IQF is a framework of leveling work qualification that juxtaposing, equalizes, and integrating education and training and work experience in order to award the recognition of the work competence in accordance with the position of work in various sectors. IQF is prepared by the Directorate General of Higher Education and the level of learning outcomes agreed nationally, compiled based on the size of the result of education and/or training gained through formal education, non-formal, informal, and work experience [1].

Through IQF, correspondence between the level of education, job training, and work experience that is owned by prospective migrant workers has become increasingly apparent that more easily search for jobs according to their competence. Thus, the preparation IQF is a real step by government to reduce unemployment, which reached 7.39 million people based on BPS August 2013 [2]. In addition, the implementation of IQF can reduce inequality in the quality of graduates among higher education. One was a teacher as output higher education that have programs for prospective teacher education. Data from the Ministry of national education in 2008 [3] states that a teacher who is not worth teaching in kindergarten, elementary, junior high, high school and vocational respectively were 78.35%, 79.45%, 27.12%, 12, 89% and 20.80%. In total, as many as 1,608,477 of the 2,837,212 teachers is not worth teaching or as a whole reached 56.69%. The data also showed that the competence of teachers in various parts of Indonesia still vary.

European Qualification Framework (EQF) is one of the qualifications framework are referenced by IQF. An initial draft EQF was first presented in July 2005 and then by the European Commission began to be discussed in depth and wide. The results were discussed at a conference in Budapest in February 2006 under the Austrian Presidency of the Council. The draft continues to be assessed and revised, until finally composed the EQF for lifelong learning in September 2006. The core of the EQF is a description of the 8 levels which demonstrate the knowledge and ability of a person regardless of where or how the knowledge and skills acquired [4]. Briefly, [5] reveals that the core of each level in the EQF is competence by the European Parliament and the Council defined as proof of a person's ability to use their knowledge and skills. In the EQF, the first level includes the skills and knowledge base to perform simple tasks in everyday life, while levels 8 provides the highest ability graduate doctoral education with the ability to create and develop science or a new profession in everyday life so as to create conditions of life which is better. EQF was able to provide solutions to a number of education issues, one of them in Germany regarding the advancement of education, the integration of general and vocational education and lifelong learning [6].

Lithuania is a country that follows the trail of EQF and divide into 8 qualification levels [7]. In contrast to Lithuania, Ireland divide qualifications in 10 degree, Scotland 12 degree, and English 9 levels [8]. So, it must be admitted that the EQF provides a very strong influence not only in other countries, but also Indonesia in defining the ability of a person at every level of qualification is called IQF.

IQF provides 9 levels of qualification, starting from the qualification level 1 as the lowest qualification and qualification level 9 as the highest qualification. Determination of levels 1 to 9 is done through a comprehensive mapping of labor conditions in Indonesia in terms of the needs of producers (supply push) and users (demand pull) labor.

Levels of classification in the IQF (9 levels) does not necessarily mean that the highest level of IQF higher than the prevailing levels of qualifications in Lithuania (8 levels) or conversely lower levels of qualification which applies in Scotland (12 levels). It is more precisely understood that the types of qualifications on IQF designed to allow every level of qualification corresponded to the needs shared between producers and users of college graduates, the culture of education/training in Indonesia today as well as the title of graduates every higher education pathways applicable in Indonesia.

IQF draft is currently being studied, formulated and disseminated by the Director General of Higher Education, and based information will take effect immediately one of them for the competence and qualifications of teachers in Indonesia. Therefore, the Director General of Higher Education requires a lot of input from various sources regarding learning outcomes either from higher education or college graduates to enhance IQF draft. Through this research, the Director General of Higher Education can do a mapping of the quality of higher education seen of graduates produced. This study is a continuation of previous research that has been successfully developing criteria learning outcomes IQF level 6 programs for prospective teacher education of Physical Education. Learning outcomes IQF level 6 itself is the level of competence that has been achieved by graduates of Bachelor's Degree through structured learning process or through work experience within the framework of IQF. In addition, this study also grounded in the results of research [9] regarding the effectiveness of the curriculum and the learning process of the education department of physics Yogyakarta State University (YSU) to IQF level 6. Here are the results. (1) The level of effectiveness of the curriculum of the aspects of planning and evaluation of learning for education and science subjects of physics with good criteria. (2) The level of effectiveness of the learning process in the classroom of the aspects of the implementation of quality learning and achievement indicators IQF level 6 education in science subjects of physics education and physics with good criteria. (3) The level of effectiveness of the learning process in the laboratory of implementation aspects of the laboratory work-based learning and achievement indicators IQF level 6 physical education with sufficient criteria. Both the research results above make an interest to see the achievement of learning outcomes IQF level 6 on physics teachers graduated from the YSU.

This study aims to find out how high the level of achievement of learning outcomes IQF level 6 by physics teacher in SHS/ISHS/VHS who graduates from YSU. The results of this study required by the Higher Education as a consideration in determining the level of IQF study programs of undergraduate physics education. In addition, the Higher Education can determine the mapping of the achievement of learning outcomes IQF level 6 physical education graduate YSU. For physical Education Study Program YSU the results of this study may provide information regarding the achievement of learning outcomes IQF level 6 in terms of graduates. As for teachers of physics, the results of this study can be used to do evaluation in order to increase the competence of teachers in teaching.

II. RESEARCH METHODS

This study is an evaluation that serves to determine the mapping of the achievement of leaning outcomes IQF level 6 physics education graduate YSU in Yogyakarta. Research approach used is descriptive qualitative and quantitative. The research was conducted in SHS/ISHS/VHS at Yogyakarta in December 2013 to March 2014. The subjects were physics teacher in SHS/ISHS/VHS who graduates from YSU in 2005 until 2012 that have been taught in Yogyakarta and uncertified educators.

Respondents were selected in accordance with a predetermined qualifications.The research carried out by describing the conditions of the process that has been or is in progress, do not control the

the state at the time of the study only measured the state according to criteria of learning outcomes IQF level 6 have been prepared. To complete this study, the curriculum of physical education, faculty of mathematics and natural sciences, YSU in 2009 were still valid also studied to see the relevance of learning outcomes criteria IQF level 6. Data were collected through questionnaires, observations, interviews, and documentation. Sheet questionnaire is used to assess the achievement of learning outcomes IQF level 6. Sheet questionnaire used consisted of four types, ie a questionnaire completed by the physics teacher, school principal, peer teacher, and students. Observation sheet used to observe the teacher while teaching. The questionnaires used as a guideline interviews with physics teacher and school principal. Sheet document was used to assess the teacher data in the form of a syllabus, lesson plan, and other documents related to teaching.

Triangulation is a leading stage before the data is analyzed. This is done by comparing and checking the data obtained from the information stakeholders involved in the research. After triangulation is fulfilled, the data were analyzed by descriptive qualitative and quantitative descriptive. Qualitative descriptive analysis was used to analyze the data such as notes of interviews and important events during the observation of the learning process. Quantitative descriptive analysis was used to analyze the data in the form of documentation of assessment results, questionnaires, and observations by comparing the scores of the observer with the assessment criteria.

The determination of assessment criteria include: (1) calculate the highest and lowest scores for each component; (2) calculate the mean ideal; (3) determines the standard deviation of the ideal; and (4) determine the degree of inclination. The level tendency is divided into four categories as shown in the following table.

Table 1. Category Rate Trends

Range of scores	Interpretation
$X \geq \bar{X} + 1\ SB_i$	Excellence
$\bar{X} + 1\ SBi > X \geq \bar{X}$	Good
$\bar{X} > x \geq \bar{X} - 1.\ SB_i$	Not Good
$X < \bar{X} - 1\ SB_i$	Very Poor

The mean ideal ($\bar{X}$) = ½ (The highest score ideal + The lowest score ideal)
Standard deviation of the ideal score (SB_i) = 1/6 (The highest score ideal - The lowest score ideal) [10].
Implementation of learning in the classroom are calculated using percentages.

$$\frac{\sum \text{Total skor}}{\sum \text{Total ideal}} \times 100\%$$

III. RESULT AND DISCUSSION

From all physics teacher in SHS/ISHS/VHS located in Yogyakarta, there are only 10 qualified teachers as respondents. Here are all research respondents.

Table 2. List of Respondents Research

No.	School	Location	Respondents			
			Physics teacher	School Principal	Peer teacher	Students
1	A*	Sleman Regency	1	1	1	13
2	G*	Sleman Regency	1	1	1	28
3	C*	Sleman Regency	1	1	1	23
4	D*	Gunungkidul Regency	1	1	1	31
5	E*	Yogayakarta City	1	1	1	28
6	F*	Gantul Regency	1	1	1	30
7	G*	Kulonprogo Regency	1	1	1	17
8	H*	Gantul Regency	1	1	1	31
9	I*	Gantul Regency	1	1	1	31
10	J*	Gantul Regency	1	1	1	14
	Total		10	10	10	246

Note: *) school identity hidden.

The results of the research achievement of learning outcomes IQF level 6 which was measured through a questionnaire sheet instruments, observation sheets, and documentation assessment sheet can be seen in Table 3 below.

Table 3. The attainment of learning outcomes of IQF Level 6 by physics teacher in SHS/ISHS/VHS who graduated from YSU In Yogyakarta

School	The questionnaire							Observation		Dokumentation		Conclusion
	Physics Teacher	Principal		Peer Teacher		Student						
	%	Skor	category	Skor	category	Skor	Category	%	category	Skor	category	
A	93	146	E	145	E	78,3	G	60	G	95,5	G	Reached
B	100	176	E	155	E	87,1	E	55	G	57,0	G	Reached
C	82	153	E	124	G	82,3	E	53	G	28,0	VP	Reached
D	91	166	E	131	G	88,6	E	73	G	48,5	NG	Reached
E	84	172	E	154	E	87,6	E	57	G	56,0	G	Reached
F	89	112	NG	111	NG	78,4	E	60	G	0,0	VP	No reached
G	89	134	G	165	E	84,9	E	50	G	40,5	NG	Reached
H	96	159	E	156	E	92,8	E	77	E	51,0	G	Reached
I	93	162	E	132	G	84,0	E	80	E	58,0	G	Reached
J	100	157	E	133	G	85,9	E	60	G	0,0	VP	Reached

Based on Table 3 above, it can be seen that the whole physics school in SHS/ISHS/VHS Yogyakarta from different schools achieve learning outcomes IQF level 6 except the physics teacher from F school. It means that, 9 of 10 teacher or 90% of teachers achieving learning outcomes IQF level 6. More detailed explanation regarding the achievement of learning outcomes IQF level 6 of each teacher can be seen in the following description.

A School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in A school is 93%. These results are supported by classroom learning activities percentage of 60% with a good category and score documentation that shows the value of 59,5 in good categories. Questionnaires completed by the school principal, peer teacher, and students each gave a score of 146 (excellent), 145 (excellent), and 78,3 (good). Thus, it can be stated that the physics teacher from A school achieve the learning outcomes IQF level 6.

In addition to the information above, interviews with teacher find information about the constraints faced by teacher for teaching, such as the unavailability of laboratory physics and physics teaching hours is too late. Another thing related to physical education courses YSU, according to the provision of teacher practicum obtained is still less to teach in the school, especially for schools that do not have a laboratory. Therefore, the study program is expected to provide students with a variety of lab mainly using practical tools that are easily obtainable or made. This can be done by reactivating the subject "tool-making" that been there before. Not only that, since A school have characteristics much different with general school, so the teachers feel there is no suitability curriculum that had been studied in YSU. Interviews were also conducted with the school principal. The teacher is a person who has a mastery of the material is very nice and willing to continue to learn. The spirit continues to learn who brought not easily surrender to circumstances. The absence of laboratories in schools to make teachers borrowed practical tool in YSU and UGM so that students can learn. Nonetheless, there is the attitude of teachers by principals not appropriate when applied in schools. Teachers are less flexible in interacting with members, especially students. It is a highlight for the principal because of the characteristics of school students who tend to be hard. If the teacher attitude is not soft, the teacher will have difficulty in teaching.

B School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in B school is 100%. These results are supported by classroom learning activities percentage of 55% with a good category and score documentation that shows the value of 57 in good categories. Questionnaires completed by the school principal, peer teacher, and students each gave a score of 176 (excellent), 155 (excellent), and 87.1 (excellent). Thus, it can be stated that the physics teacher from B school achieve learning outcomes IQF level 6.

Information through interviews with teachers known that the obstacles encountered during teaching at school B, one of which are the amount of teaching hours (32 hours per week) and level of education (class X, XI, and XII). It makes teachers' difficulties in absorbing the material, especially the class XII for new teachers teaching the class XII this year.

Another thing related to YSU physical education courses, teachers stated that the material was viewed less as a provision of teaching in schools is "modern physics", while according to teachers' practicum is sufficient. In addition to the above constraints, the use of pesantren school's curriculum making curriculum materials that have been studied at YSU are becoming less relevant. Interviews were also conducted with the principal. According to him, the physics teacher who taught in a private school is a sociable so easily close to the students and the environment. In addition, the teacher is a patient personal. Therefore, teachers are able to evaluate in detail. However, teachers do not use the results of evaluation of learning in research to improve learning.

C School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in C school is 82%. These results are supported by classroom learning activities percentage of 53% with a good category. The questionnaires completed by the school principal, peer teacher, and students each gave a score of 153 (excellent), 124 (good), and 82,3 (excellent). Nonetheless, scores documentation indicates a value of 28 categorized very poor cbecause the teacher does not collect syllabus. The syllabus is one criteria for assessment documentation. Thus, it can be stated that the physics teacher from C school achieve the learning outcomes IQF level 6.

The results of interviews with physics teachers show that the limitations of the laboratory is one of the constraints of teachers for teaching so that teachers doing practical difficulties. In addition, school-based schools make student learning a heavy loads. Impact, students can not focus in learning physics. Obstacles is felt teacher also recognized principals through interviews. As far as the principals, teachers only demonstrated in the classroom.

D School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in D school is 91%. These results are supported by classroom learning activities percentage of 73% with a good category. However, a score of documentation demonstrating the value of 48.5 with not good category. The low score due to lack of documentation acquisition point on several aspects, namely the quality of student worksheets were developed, exploiting the potential of local/junk in learning, award certificates owned, and research results owned. Questionnaires completed by the school principal, peer teacher, and students each gave a score of 166 (excellent), 131 (good), and 88.6 (excellent). Thus, it can be stated that the physics teacher from D school achieve learning outcomes IQF level 6.

The results of interviews with teachers saying that the constraint teachers in physics learning include student input is low and the lack of a laboratory so that teachers rarely do practicum. Unavailability laboratory at school contrary to the information submitted principals. According to him, the school already has a laboratory with complete equipment. Only, it is located across the street school so it is not visible. Personal teachers according to school principals silent and only interact as needed to make possible the teacher did not know the existence of the laboratory.

E School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in E school is 84%. These results are supported by classroom learning activities percentage of 57% with a good category and score documentation that shows the value of 56 in good categories. Questionnaires completed by the school principal, peer teacher, and students each gave a score of 172 (excellent), 154 (excellent), and 87.6 (excellent). Thus, it can be stated that the physics teacher from E school achieve learning outcomes IQF level 6.

Interviews with teachers revealed that the constraint is the low teacher for teaching mathematical abilities of students, thus hindering the achievement of learning physics. Another point highlighted by the teachers about the courses of physics education is the lack of provision of theories about how to treat students in learning physics. Because according to teachers, methods and learning model that had been obtained in the course seem very theoretical and difficult to apply in school. Therefore, teachers hope the program can study it carefully. In addition to the teacher, interviews were also conducted with the principal. According to him, the teacher already has competence in accordance with the profession, such as being able to utilize and manage the laboratory, able to interact well, to conduct assessment and evaluation of learning. Only recognized principal that the teacher had not yet reached the stage of conducting research to improve the learning of physics.

F School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in F school is 89%. These results are supported by classroom learning activities percentage of 60% with a good category. However, a score of documentation precisely show the value of 0 (very poor) because teachers do not collect syllabus and lesson plan as a condition assessment documents. Questionnaires completed by the school principal, peer teacher, and students each gave a score of 112 (not good), 111 (not good), and 78.4 (good).

Discrepancies in data from several sources over later further analyzed based on interviews with teachers and principals. Teachers reported that obstacles faced during teaching physics at school is limited equipment and materials lab, learning physics do four hours a week with each meeting 40 minutes so it does not meet to practice; student learning load is too heavy for the amount of material that must be learned (school-based schools); the admission IPA/physics only be seen from the interest; the teacher is the single physics teacher. Information on the constraints of teachers for teaching then rechecked by an interview with the school principal. To the problem, the principal stated that teachers are less able to utilize and manage the laboratory for learning physics. According to him, the existing laboratory with various limitations should be used properly. In addition, the school head teacher also regretted never give feedback or ideas in a meeting or at a school meeting to address the problems they experienced. As far as the school principal, teachers rarely interact with members of other schools such as talking with other teachers. To see more about the lab problems, checking the laboratory by researchers. As a result, the lab there but the situation is less well maintained and still fused with chemistry and biology laboratories. The tools and materials in the laboratory is sufficient for students to practice simple physics. Confirmation was also made about the teacher who did not leave the syllabus and learning implementation plan as part of the assessment process documentation to the school. Against this, the school principal stating that the syllabus and lesson plan made the teacher in the previous semester (1st semester) collected the final, while the syllabus and lesson plan this semester (second semesters) have not been collected. Information from physics teacher peer mentioned that some students had asked teachers of physics to be replaced. However, because the teacher is singke so the student did not have any other choice. Chat students shortly after completing the questionnaire form, "who is honest in a survey?" indicates that there are things that are not disclosed students through questionnaires. Based on all the resources it can be concluded that the physics teacher in F school not achieve the learning outcomes IQF level 6.

G School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in G school is 89%. These results are supported by classroom learning activities percentage of 50% with a good category. However, a score of documentation does not support the value of 40.5 and not good category. The low score is because teachers documentation does not mention the learning objectives in the lesson plan, teaching materials are not developed, the learning method is not varied, not compile quality worksheets and teaching materials, do not use second-hand goods in learning physics, does not have a certificate of appreciation and research. Questionnaires which has been filled by the school principal, peer teacher, and students each gave a score of 134 (good), 165 (excellent), and 84.9 (excellent).

The results of interviews with teachers mentioned that there are some obstacles encountered during the implementation of learning physics include: student input is very varied and less well, student misbehavior is hard to control, and does not have a physics laboratory. However, teachers are greatly helped by the flash media that formerly studied at YSU for use in class. In addition, the school laboratory limitations anticipated by the practice of using materials around. Stock is lacking obtained teachers from YSU is the material on the psychology of children in learning. This thought is very important given the delinquency rate is difficult to control their students. Teachers also had difficulty with the school curriculum developed referring to the productive practice. Meanwhile, the curriculum studied physics at YSU is not earmarked for vocational education. Information generated from interviews with school principals are not much different. Physics laboratory equipment is still minimal.

For the purpose of the practice done by buying the necessary materials only (incidental). However, if the existing physics laboratory, principals believe teachers are able to utilize and manage the laboratory. Based on the information above, it can be concluded that teachers achieve learning outcomes IQF level 6.

H School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in H school is 96%. These results are supported by classroom learning activities percentage of 77% with a excellent category and score documentation that shows the value of 51 in good categories. Questionnaires which has been filled by the school principal, peer teacher, and students each gave a score of 159 (excellent), 156 (excellent), and 92.8 (excellent). Thus, it can be stated that the physics teacher from H school achieve learning outcomes IQF level 6.

The results of interviews with teachers said that the obstacles faced by teachers for teachinginclude: no tools and labs, students are less good numeracy because the input is less good. To anticipate the lack of laboratory tools that teachers take the initiative to create their own tools. It also justified the principal. According to him, the procurement of new physics lab pioneered the stage for a new school stands 3 this year to prioritize the procurement of laboratory for vocational beforehand. Physics laboratory while still a part of the laboratory department.

I School

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in I school is 93%. These results are supported by classroom learning activities percentage of 80% with an excellent category and score documentation that shows the value of 58 in both categories. Questionnaires which has been filled by the school principal, peer teacher, and students each gave a score of 162 (excellent), 132 (good), and 84 (excellent).

The results of interviews with teachers illustrates that the teacher did not experience significant obstacles for teaching physics in school. According to him, the provision of material obtained from the study of physics program, YSU have been enough to teach. Instead, lab supplies are lacking. For that, the lab needs to be added. Interviews with principals do not do because the principal is not willing. Instead, the interviews conducted with colleagues. According to him, the teacher has the ability to utilize technology is quite good. She once sent to attend training and use of technology to produce "pesona.edu". In addition, although the teacher has not been formally provide feedback on a forum, but informally active teachers to provide feedback or ideas in solving a case. Thus, it can be stated that the physics teacher from I school achieve learning outcomes IQF level 6.

J Sekolah

Score questionnaire has been filled teachers indicated that the percentage of achievement of learning outcomes IQF level 6 by physics teacher in J school is 100%. These results are supported by classroom learning activities percentage of 60% with a good category. Nonetheless, scores obtained documentation does not support two scores above is 0 (very poor) because the teacher did not make the syllabus and learning implementation plan. Questionnaires completed by the school principal, peer teacher, and students each gave a score of 157 (excellent), 133 (excellent), and 85.9 (excellent).

The results of interviews with teachers show that there are several obstacles faced by teachers for teaching include: facilities/infrastructure is limited because it does not have a lab, student input in the form of entry primary school thinking skills and interests. Another thing related to the study of physics YSU program is teacher states that matter and lab equipped with Prodi on the application of ICT in learning is still low. To anticipate this, the teachers try to learn by way of self-taught. The interview with the school principal was not done because of being out of town. Based on the above information, it can be concluded that the physics teacher from J school achieve learning outcomes IQF level 6.

IV. CONCLUSIONS AND RECOMMENDATIONS

Based on the results, 90% physics teachers at SHS/ISHS/VHS who graduated from Yogyakarta State University reached 92% learning outcomes of IQF level 6. YSU physics education courses need to add or reactivate a course towards achieving social competence in order to achieve the learning outcomes of its graduates IQF level 6. One of the subjects that need to be reactivated is counseling that is based on the curriculum of physics YSU 2009 are not yet listed. Department of Education need to conduct training on IQF level 6 to determine the distribution of the competence of teachers and to provide training to teachers who have not reached the IQF level 6. It is necessary to remember teachers from various universities. Schools as education providers should create conditions conducive not only to teach but also to socialize among members of the school. Thus, it will awaken familiarity among members of the school. Teachers should not make the limitations of the laboratory in the school as the only obstacle in doing practical work. Teachers can use the tools in the environment or even make a simple tool. If the matter still can not be implemented, at least using the teacher demonstration or take advantage of internet media for learning. For other researchers who want to conduct similar research, arranged interviews with school principals implemented. Based on experience, information from the principal is more complete.

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VALIDITY OF COLLABORATIVE CREATIVITY MODEL

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Abstract— Collaborative Creativity (CC) instructional model is instructional model to training students' scientific creativity and scientific collaborative with apply CC which describe procedures systematically and used to guide teachers to help students how to identify problems, exploring creative ideas, collaborative creativity, elaboration, and evaluation of creative process and scientific collaborative creativity results. Validity of instructional model determined by validating the model against its validity. The CC instructional model validity is reviewed based on two aspects, content validity and construct validity. The content validity is used to assess the CC instructional model content that reviewed from: 1) needs, and 2) state-of-the art knowledge. The Construct validity is used to assess the CC instructional model components from: 1) consistency, and 2) logically. This research aims to check the CC instructional model validity that developed to teach students' scientific creativity and scientific collaborative. The research focus is directed for the CC instructional model validity that consists of the content validity and the construct validity. Validation against the content validity and the construct validity of the CC instructional model is done through the Forum Group Discussion by 3 experts. The result of contents validity and construct validity model shows that the CC instructional model is very valid.

Keywords: *validity, collaborative creativity, instructional model, physical science*

I. INTRODUCTION

Developments in science and technology is growing rapidly so that spur us to improve human resources. Improvement of human resources required for the mastery of science and technology is largely determined by the mastery of science. Mastery of science can pursue through improving the education quality and teaching science. Science is a study to find out about a systematic nature, so that science is not only a mastery of knowledge in the form of facts, concepts or principles, but also a process of discovery. The learning process emphasizes providing direct experience through inquiry to develop competencies to explore and understand the universe around scientifically (Kemdikbud, 2013: 175). Learning science for junior high school on Curriculum 2013 is to reach competency standards graduates consisting of dimensions of attitudes, knowledge and skills. On the attitude dimension, qualifying ability is to have behavior that reflects the attitude of the faithful, noble, knowledgeable, confident, and responsible to interact effectively with the social and natural environment in a range of relationships and existence. On the dimension of knowledge, students' qualifications are mastery the factual, conceptual, and procedural knowledge in science, technology, arts, and culture with human insight, national, state, and civilization-related phenomena and events that seem eye. While the dimensions of qualification skills, students must mastery the ability to think and the ability to follow an effective and creative in the realm of the abstract and the concrete by the learned in schools and other similar sources (Permendikbud No 54/2013).

Guilford (1973) suggested ways of creativity is divergent thinking, productive thinking, inventive thinking heuristics and lateral thinking. Appropriate framework 21st Century Learning, that "Learning and Innovation" includes: creativity and innovation, critical thinking and problem solving as well as communication and collaboration in the context of high-level thinking. Higher-level thinking skills according to Krathwohl (2002) defined as the cognitive abilities of students at a level according to Bloom's taxonomy of cognitive abilities of analysis, evaluation and creative. Higher-level thinking is the embodiment of critical thinking, creative, and solve problems. According to Sternberg (2008) scientific creativity skills include creating, discovering, inverting, imagining, supposing and hypothesizing. It is clear that within the framework of the 21st century, in solving problems students should be able to develop creativity and innovation, critical thinking and problem solving as well as communication and collaboration. Therefore, it is necessary to do an effort on how to develop the scientific creativity of students through the CC instructional model that is able to develop the scientific creativity ability. Scientific creativity in science education consists of several aspects which include: knowledge, intellectual ability, personality and motivation, and environmental (Liu & Lin, 2013), the ability to learn scientific knowledge and solving scientific problems (Wang and Yu, 2011), producing Certain original, useful for specific purposes (Hu et al., 2013), and social or personal worth (Hu & Adey, 2010) as well as studying the essential nature and excellence of scientific thought (Zhang et al., 2014). Solving problems in science requires students to explore a collection of knowledge that he has had, imagining the way to completion and often create combinations of knowledge or new techniques to achieve a solution (Nur, 2014: 73). Therefore, to assess the scientific creativity will use the scientific creativity test developed by Hu & Adey (2010) in The Scientific Structured Creativity Model (SSCM) as a basis of measurement theory of scientific creativity.

CC is defined as the perspective of creativity, which is an inherently social process that promotes the creative process in the form of partnerships collaborative in completing group tasks (Miels & Litleton, 2007). Creativity involves a collaborative process of scientific creativity to generate the new ideas through the social processes (social production process) taking into account the motivation of groups' interaction and efficiency in groups' work. Grossen (2008: 246) states that the collaborative creativity is required in learning to produce a new understanding by making elaboration. The CC also shows how the potential and the balance of participation can improve the contribution of the scientific creativity. Thus the collaborative creativity plays an important role in determining the success of student learning and enhance the contribution of the scientific creativity skills (Partlow, Medeiros & Mumford 2012: 30). The CC instructional model is a instructional model for teach skills of scientific creativity and scientific collaborative by applying the CC which describes systematic procedures and are use to guide teachers in helping students how to identify problems, explore creative ideas, collaborative creativity, elaboration of ideas creative and evaluation process and the results of scientific creativity. The CC instructional model content validity is reviewed based on 2 aspects,1) the content validity and 2) the construct validity. The CC instructional model construct validity is to assess the content validity of CC instructional model in terms of: 1) needs, 2) advanced knowledge. The construct validity to measure the validity of CC instructional model in terms of design CC instructional model consistently and logically (Nieveen, 2007).

Based on the description above, the validation of the content validity and the construct validity of CC instructional model will be conducted by 3 experts in a focus group discussion to check the CC instructional model validity. Activities, which validate each step of the CC instructional model syntax consists of the following steps: Identify the problem, Exploration creative ideas, Collaborative Creativity (CC), Elaboration of creative ideas and the evaluation process and the results are applied to teach the skills of scientific creativity and mastery science students in learning concept. Based on the description above, it can be formulated problems: 1) How is the CC instructional model content validity that developed to teach the students scientific creativity in learning? 2) How is the CC instructional model construct validity that developed to teach the scientific creativity of students in learning?

II. LITERATURE REVIEW

A. *Instructional model*

The instructional model is a description of an overall approach or a teaching plan that includes goals, steps, learning environment, and system settings. Joyce and Weil (2009), says that every model of learning has the following elements.

1. Syntax are the stages of the activities of the model.
2. The social system is the situation or atmosphere and norms in the model.
3. The principle of the reaction is a pattern of activity that describes how teachers see and treat the students, including how should teachers give the response to them.
4. The support system is all the means, materials and tools necessary for implement the models.
5. Impact is the instructional learning outcomes are achieved directly by means directing students at the expected goals.

6. Impact accompanist are other learning outcomes produced by a process learning, as a result of the creation of a learning atmosphere that is experienced directly by the students without getting the direct guidance of a teacher.

Teaching is often interpreted as an actual face to face interaction between teachers and their students (Arends, 2012: 259). Teaching is covered by the use of instructional approaches or models to suit the characteristics and nature of students in a class and type of objectives to be achieved by the teacher. Such approaches are called to teaching models (models of teaching). The concept includes a teaching model teaching approach overall broad and not specific strategy or technique. Teaching model has several attributes, which is the theoretical basis of coherent or a viewpoint on what should be learned and how they learn, and the model it recommends a variety of teaching behavior and class structure needed to realize the various types of different learning (Arends, 2012: 259). The concept of teaching model is very important function as a communication tool for teachers. According to Joyce & Weil, 1972; Joyce, Weil & Calhoun, 2004) (cite in Arends, 2012) classifies various approaches of teaching according to the instructional purpose, syntax, and the nature of learning environment. Instructional objectives related to student outcomes (results achieved by students), while the syntax of the model is the overall flow of learning activities and learning environment is the context that all measures should be implemented including teaching in a motivating and management procedures for students. Based on the above can be defined that the instructional model is a conceptual framework that describes a systematic procedure in organizing learning experiences to achieve specific learning objectives, and serves as a guideline for the designers of learning and teachers in the management of student learning. Position instructional model in teaching and learning activities as a tool or means that a concept used by a teacher during the learning in the classroom. The success of teaching purposes other than useful for the students, it is also useful for teachers is to add technical mastery in developing learning activities and can design effective teaching environment, fun, and rewarding. The use of the instructional model relies heavily on teachers, how teachers manage the class could unite model of learning to classroom conditions. Situation or atmosphere of teaching is a supporting factor in implementing the instructional model. Application of instructional models as a teaching strategy is needed in creating learning conditions that could encourage the spirit and confidence of students to learn.

B. Content validity and construct validity for CC model

The content validity according to Nieveen (20002) is “there is a need for the intervention and its design is based on state-of-the-art (scientific) knowledge.” Aspects of assessment in the content validity include: 1) the needs of the development model of CC, 2) knowledge of cutting-edge (State of the art of knowledge), 3) model CC could encourage further research focus to the community, universities, primary and secondary. The Construct validity is used to measure the validity of the validity of the model in terms of the consistency (consistency design) and logically supporting component model (Nieveen, 2007: 26). Aspects of construct validity assessment in include: 1) Rationalization model of CC, 2) support theoretical and empirical of CC model, 3) Syntax of the CC instructional model, 4) Principles of reaction, 5) Learning environment and classroom management, 6) Implementation evaluation (Joyce and Weil, 2009). The CC is a creativity perspective as an inherently social process that promotes the creative process in the form of partnerships collaborative in completing creative tasks (Miels & Litleton, 2007). CC on the implementation process and the impact on student learning outcomes. Collaborative creativity is also closely linked to the social processes and the limitation on an understanding of the creative process that affects the affective aspects of the group. The discussion on creativity and behavior requires an understanding of the relationship between the content of cultural and social systems (Miell and Littleton, 2007: 148). Collaborative learning creativity requires the conditions in which students can design, build, and feel the social environment can be transformed into an idea (Jones, Miel, Littleton, Vass, 2008: 92). When the teacher gives a task related to the involvement of students in the group, then each team member can contribute a unique and every effort made students need to focus on the performance of collaboration. It encourages students to practice the skills of scientific creativity and creative while helping students who do not have the skills of teamwork.

Torrance (1990) considers fluency, flexibility, originality and creativity as the main feature. Smoothness mean number of original ideas are generated, flexibility is the ability to 'change tactics,' not bound by the establishment thinking and approach even after that approach is found no longer work efficiently Authenticity interpreted as: the answers are rare, occurring only occasionally in certain populations. Hudson (1966) considers fluency, flexibility and originality similar to the approach. In class activities, the students ask students to think about how much is likely to be using bricks, he gathered all the answers and give higher scores to answer rare (occurring only rarely) rather than a general answer. Fluency, flexibility and originality form one-dimensional models, one of which can be described as a personality trait that is characteristic of creative people (Hu & Adey, 2010: 3). Although divergent thinking is no longer considered synonymous with creative abilities, but it remains an important component of the creative potential (Runco 1991).

C. Focus Group Discussion (FGD)

In order to obtain a valid instrument on instructional model and learning tool, it is necessary to test to the learning tool instrument and instructional model instrument through a discussion forum called FGD. FGD is a small group discussion where participants respond to a series of questions that focused on a single topic (Marreli, 2008). FGD is a process of gathering information about a certain very specific problem through group discussion. Guide the implementation of the Focus Group Discussion (FGD) was developed with several goals:

1. Guiding the discussion so that implementation can take place in accordance with the expected goals.
2. Obtain feedback from participants on the validity of Collaborative Creativity Model (CC) developed includes rationality, theoretical and empirical foundation, CC model development, the characteristics of CC models, syntax, social system, the principle of reaction, support systems, the impact of instructional and accompanist, learning plan, the learning environment and classroom management, and evaluation.

III. METHOD

This research is oriented to product development. The resulting product is an instructional model that is valid for teach skills of scientific creativity and scientific collaborative student. As described above, this study aims to: (1) know the content validity CC models were developed to teach students scientific creativity in learning, (2) knowing the construct validity CC models were developed to teach the scientific creativity of students in learning. The draft for the achievement of the objectives of research using descriptive qualitative approach, which describe the results of the validation have been done by an expert in FGD for the development of CC instructional models. The data needed to achieve the goal is the result of data validation experts. Analysis of the data to answer the problem and achieve the goal of the research was done by using descriptive.

IV. RESULTS AND DISCUSSION

Based on the background of the problems that comes on Curriculum 2013 and the framework of thinking which refers to the development of a collaborative creativity model, it can be validated models are performed by experts, with reference to the aspects of content validity and construct validity of the model. Validation of the instructional model CC performed to obtain a valid CC instructional model to teach skills of scientific creativity and scientific collaborative.
Results of the validation of the content validity shown in Table 1.

TABLE 1. Results of validation of the content validity

No	**Rated aspect**	**The average score**	**K**	**R (%)**
1	Needs of Development CC Instructional Model	3.50	VV	85.71
2	State-of-the art of knowledge	3.67	VV	90.48
3	Benefit	3.33	VV	85.71
Average		**3.50**	**VV**	**87.30**

Results of the validation of the construct validity shown in Table 2.

TABLE 2. Results of the validation of the construct validity

No	**Rated aspect**	**The average score**	**K**	**R (%)**
1	Rationality of CC Instructional Model	3.67	VV	92.86
2	Theoretical Support and Empirical Support of CC	2.89	V	95.00

	Instructional Model			
3	Syntax of CC Instructional Model	3.67	VV	90.48
4	Social System of CC Instructional Model	3.93	VV	97.14
5	Principle Reaction of CC Instructional Model	3.33	VV	90.48
6	Learning Environment and Classroom Management	3.42	VV	76.19
7	Evaluation	3.33	VV	85.71
Average		**3.46**	**VV**	**89.69**

Description: K = Criterion, R = Reliability, V = Valid, VV = Very Valid

Based on the purpose and implementation of the FGD can be said that the FGD is one way that is effective and efficient validate in the hypothetical model and validate the learning tools that support the model.

V. CONCLUSIONS AND SUGGESTIONS

A. Conclusion role in this research are:

a. The contents validity of the CC instructional model judged on aspects development needs of CC instructional model, advanced knowledge (State of the art of knowledge) and benefit and the results obtained are very valid.

b. The construct validity of the CC instructional model was evaluated based on rationality, theoretical and empirical support, syntax, social system, principle reaction, learning environment and classroom management, implementation of evaluation and the results obtained are very valid

B. Suggestions

a. Still needs to study the CC instructional model on the main learning on habituation in scientific creativity and scientific collaborative.

b. In addition to study the teachers' role as a facilitator as well as a motivator so that the teacher should be able to continue to motivate the students so that students can play an active role in the development of scientific creativity and scientific collaborative students.

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PE-13

Validity of Physics Module Using Cooperative Learning Model With Peer Assessment

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***Abstract*—**This research is motivated by the various in the speed of learning and passive students during learning. In addition, SMA Muhammadiyah 1 Banjarmasin no modules are used in physics learning. This study aimed to describe the validity of modules developed in class X SMA Muhammadiyah 1 Banjarmasin. Physics module validation consists of material and media validation. Validation of the material consists of content quality, organization, language, evaluation, and glossary. The media validation consists of consistency, format, appeal, the shape and size of letters, and languange. The results showed the validity of the module is very valid category. It was concluded that the physics module using cooperative learning with peer assessment eligible for use in learning.

Keywords: *validity, physics module, peer, assesment*

I. INTRODUCTION

Paradigm the teacher learning had changed. This is occurs in learning physics. The teacher is source of knowledge turned into a facilitator, tutor, and learning partner. Learning of paradigm had changed from teacher center to student center does not only have an impact on the methods and learning activities, but also the methods of assessment. Therefore, the learning process is directed to develop the potential of students to be able to achieve qualifications and competency.

The learning process in schools is still a lot of emphasis on developing the potential of student as individuals and less to develop the potential of students as a group. The success is only rated as independence rather than interdependence. Therefore, learning with individual approaches need to be combined with group-based approaches. One group-based learning model is cooperative learning. Cooperative learning is a learning situation that involves two or more individuals who are attempting to have a shared educational experience [1].

Besides to developing the potential of students in the group also need innovation in learning. One innovation in learning is developing instructional media. One of instructional media could be used are learning materials. That learning material could be used is a module. The module is to reduce the various in the speed of learning through self-learning activities. The use of modules in learning can involve students activities [2]

Ideal learning process should be followed by a proper assessment. One method of learning outcomes assessment on student center is peer assessment. Application of peer assessment in learning is not mean to replace the conventional assessment method but to be a supporting assesement. Peer assessment is a direct appraisal not only of what has been learned (outcomes) but also of the where-to and the how of learning (processes). More specifically, using peer assessment helps students to develop certain skills in the areas of, for example, communication, self-evaluation, observation, and self-criticism [3].

First observations in physics learning at class X SMA Muhammadiyah 1 Banjarmasin were found: (i) students are passive in learning; (ii) there are various in the speed of learning (iii) there are not found learning materials as form of module and there are learning materials from the publisher. An alternative to solving the problems is developed the physics module using cooperative learning with peer assessment. Therefore, the research aimed to describes the validity of physics module using cooperative learning with peer assessment at class X SMA Muhammadiyah 1 Banjarmasin.

II. METHOD

Validation of the research are conducted by valiator (material specialists, media specialists, and physics teachers. The instruments used for validation is the validation sheet. The results of validator assessment were analyzed using the average score. The results of average scores adjusted with aspects criteria as in Table 1 [4].

Table 1. Criteria Validation Aspects of Material and Media

No	Interval	Category
1	X > 3.20	excellent
2	2.40 < X ≤ 3.20	good
3	1.60 < X ≤ 2.40	average
4	0.80 < X ≤ 1.60	weak
5	X ≤ 0.80	poor

The average score is used to calculate the validity. Criteria of validity shown in Table 2 [5].

Table 2. Criteria of Validity

No	Percentage	Criteria of validity
1	85.01 - 100.00	Very valid or can be used without revision
2	70.01 - 85.00	Valid or can be used but with minor revision
3	50.00 - 70.00	Not accurated, it is not recomended to be used because it should be revised majority
4	0.00 - 50.00	Invalid or may not be used

III. RESULT AND DISCUSSION

Validation of physics module consists of material validation and media validation. Validation of the material consists of content quality, organization, language, evaluation, and glossary. The media validation consists of consistency, format, appeal, the shape and size of letters, and languange. The results materials validation of module shown in Table 3.

Table 3. The Results Materials Validation of Module

Aspect	Average score	Category
content quality	3.94	excellent
organization	4.00	excellent
language	3.75	excellent
evaluation	3.25	excellent
glossary	4.00	excellent
percentage	95.59	
validity	very valid	

Aspects of content quality is excellent category. There are shown: (i) modules are developed in accordance with the basic competencies and learning objectives; (ii) material in modul accordance with physics concept; (iii) the picture presented in the module can be help students to understand the material. Aspects of organization is excellent category. That is shown the material in the modules be arranged as systematic and coherent. Aspect of language is excellent category. That is shown the language used in accordance with the spelling enhanced. Aspects of evaluation is excellent category. The tasks and competency tests in the module can to measure the achievement of learning goals. Aspects of glossary is excellent category. That is indicates the presentation according to the glossary of terms and accuracy in alphabetical order. Overall, the results material validation of module is 95.59% and be categorized as very valid.

Table 4. Results Media Validation of Module

Aspect	Average value	Category
consistency	3.67	excellent
format	3.50	excellent
appeal	3.50	excellent
the shape and size of letters	3.80	excellent
languange	3.00	good
percentage	89.42%	
validity	very valid	

Table 4 shows the results media validation of module. Aspects of consistency is excellent category. That is shows the consistent using of shapes, font size, and spacing. Aspects format is excellent category. That is shows the using of the column is in conformity with the shape and size of paper, the layout and format in accordance with the typing paper format. Aspects appeal is excellent category. That are showns the image and the size of images in a clear and attractive. Aspects of the shape and size of letters are excellent category. Those are shows the shape and size of the letters on the module is easy to read. Aspects of language is good category. That is shown the language used in accordance with the spelling enhanced. Overall, the result media validation of module is 89.42% and be categorized as very valid.

The results of the materials and media validation are very valid category. The validation results is shows the module eligible for use in learning. Designing and developing modules are need to pay attention to some elements among other formats, organization, font size, empty spaces and consistency. Those are produced learning modulesbe able for effective learning [6]

IV. CONCLUSION

The results of the validation of materials and media are very valid category. The validation results is shows the module eligible for use in learning

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PE – 14

Syiar Fisika Melalui Sosial Media: An Effort to Change the Habit of The College Students in The Use of Social Media

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***Abstract*—** An effort to change the habit of the college students in the use of facebook has been done. it aims to change the their habit in the use of facebook, that usually used as a vent media, photo sharing, and even show off, turn it into a sharing media for physics, especially physics in Islam. The subjects of this research are the 5th semester student of Physics Education Study Program Universitas Ahmad Dahlan Yogyakarta. In one semester they were given a task to post physics content on their facebook "wall" with a hash tag #darikitauntukanda, once a week at minimum. At the end of the semester they must collect their post history including comments and anyone who likes their post. The result of this research is a habit of the college students in the use of facebook at a positive way, as a physics knowledge sharing media. As this research is just getting started, we expect it can be a trigger for students to be wise in using a social media. We also collect their thoughts about "Syiar Fisika Melalui Media Sosial" movement.

Keywords: *arranged, alphabetically, maximum, five, words* [TNR 9, Italic]

I. INTRODUCTION

In the middle of 21st century, the use of internet has come out from its origin. At the beginning of internet era it used as a data exchange [1] in business environment. Then it began to spread to the academic realm as a source of information. Nowadays, the use of internet has penetrated in every part of human life. Human activity is depending on the existence of internet. Any information can be found in it [2].

The birth of social media has increased the human dependent on the internet, myspace, LinkedIn, Friendster, mig33, and so on were the first generation of social media. Twitter, Google+, and Facebook still the most used social media this day. Meanwhile, facebook has a huge number of users, about 1.5 Billion [3].

Today, Facebook users are not limited to age; kids, teenagers and even parents already have a facebook account [3]. Facebook users are dominated by teenagers, students, and college students [4].

The use of facebook in teens age is more to be a media to show who they are, to attract other people, even threat them. This phenomenon is too dangerous if not taken seriously because through facebook account anyone can recognize a person's character. Even more dangerous if they share their location on facebook then anyone will so easy to commit a crime to them.

At the beginning social media is aimed to be a media to create, share, and exchange information trough a virtual groups [5] slowly become a digital diary which can be easily read by anyone. This is what we concern about in this paper. Trying to attune the college students on using social media as what it aimed for.

To change the bad habit of college student in the use of social media into a worthy habit such as share a useful knowledge and information to the society. In this case, student is asked to post information about physics, especially physics in Islam's point of view.

II. THEORETICAL STUDY

A. Social Media

Social media is the newest web technology that allows us to communicate, participate, share, and build community online, so the users can share their contents. Blog's contents, tweets, videos on youtube, can be produced and seen directly by millions of people and free [5].

Social media can be found in many forms, such as twitter, facebook, and blogs. Facebook is a type of social networking that can be a place to get a new friend around the world, and they can communicate each other. Facebook can be used to share information, photo, video, etc [6].

The main features of facebook are home, pages, and groups, with these features users can update their status, give a comment and like on the other status. Besides that, facebook has a chatting feature that allows us to chat directly with other user, share photo, make a photo album, and make a video album up to two minutes of duration and 100 MB in size [6].

B. Instructional Media

Media is a tool which has capability to deliver a message [7]. According to Briggs, media is a physical tool that presents message and stimulate students to learn. Meanwhile Schramm argued, media is a technology that brings information or instructional message that can be manipulated, seen, heard, and read. Thus, instructional media is a tool that serves to convey a message of learning [8].

C. Behaviorist Learning Theory

According to Skinner's behaviorist learning theory, based on the idea of operant conditioning [9], at first will be given antecedent (guide) to the student to post something about physics. Then it will create a new behavior from this guide. It can be seen from how often they post about physics on their facebook account. Finally this habit will deliver a consequence for them such as numbers of like, comments and also a discussion inside their post. This is became a reinforcement to students to post physics content.

III. METHODS

Among 1 semester, students who take Teknologi Media Pembelajaran subject are ask to post any physic contents in their facebook account include a hash tag #darikitauntukanda once or more a week. In the end of the semester, students must collect their post history log book, including anyone who comments on their status as well as likes them.

IV. RESULT

Social media has delivers a serious impact on children's growth. Information access from social media is too fast and cannot be avoided. There must be a real act to change the use of social media as a show off media into knowledge sharing media.

This research is just a small step to begin, it needs support from all parties. By requiring students to post relating to physics on social media are expected to habituate them to use social media positively.

Not only a private post that gain a like, but also a post about physics gains a lot of likes as shown in figure 1 below.

FIGURE 1. SCREENSHOT OF STUDENT'S POST

and even become a discussion forum, as shown in figure 2.

FIGURE 2. DISCUSSION THAT OCCUR ON STUDENT'S POST

Based on monitoring, a few students still post about physics, although the given time to is over as shown in figure 3. It shows that this method is relatively effective.

Just like a child, if we want them like to read then we have to habituate them since now. In this case, if we want students to use social media positively, then we have to habituate them. Even force them to do that.

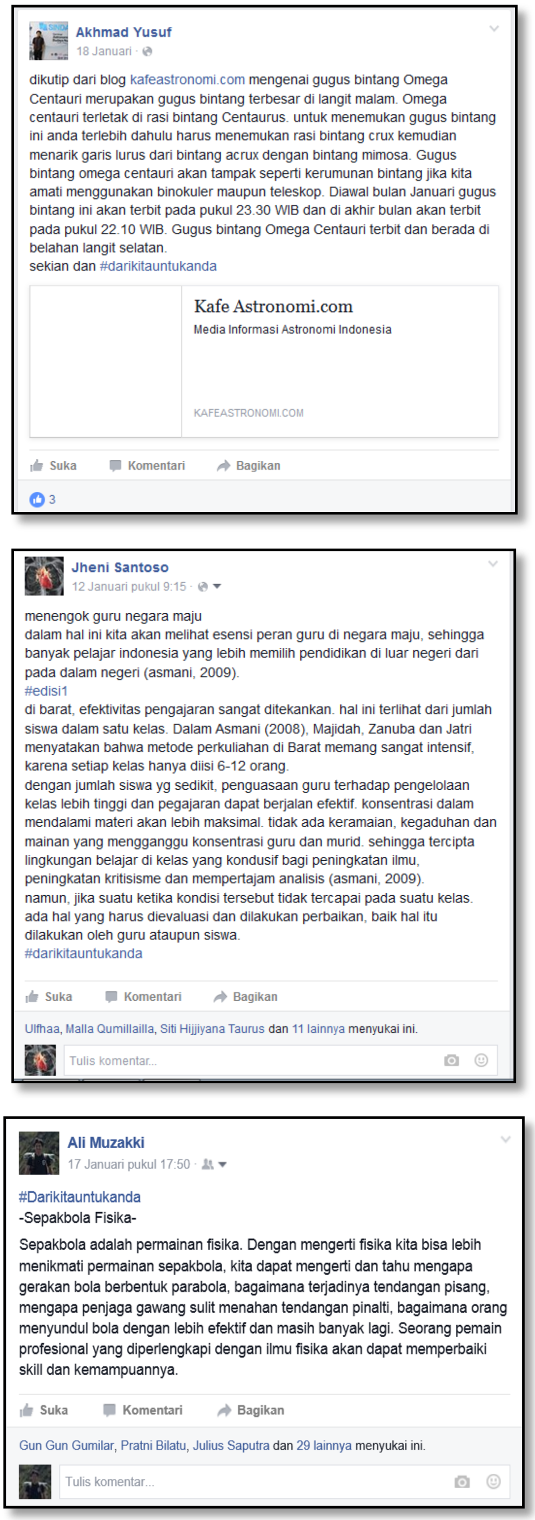

FIGURE 3. STUDENTS POST AFTER THE GIVEN TIME.

V. CONCLUSION

Student's behavior in the use of social media (tend to be negative) can be turned into positive behavior by share a physics article. This change can be done by habituation.

Although only one semester, it is expected to lead students so they can be wise in the use of social media. If many people do this method, then undoubtedly it can be a “Syiar Fisika Melalui Social Media” movement.

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Chemistry and Chemistry Education

C – 01

Synthesis of in-house PEDOT/PSS dispersion and its performance on OPV device

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Abstract— Performance of Organic Photovoltaic (OPV) device based on poly(3-hexylthiophene)(P3HT) as donor and [6,6]-phenyl-C_{61}-butyric acid methyl ester (PCBM) as acceptor has been studied using in-house PEDOT/PSS dispersions layer treated by ethanol or 2-propanol. PEDOT/PSS dispersions were synthesized by oxidative polymerization of 3.4-ethylenedioxythiophene (EDOT) monomer in the presence of PSS as a dopant in aqueous solvent, and $Na_2S_2O_8$ and $Fe_2(SO_4)_3$ as oxidation agents. The reactions performed in various ratios of EDOT:PSS by weight with respect to the EDOT monomer, and varied time of reactions. An OPV device was built onto a glass substrate in layers. The results showed that the tendency of increasing conductivity is not consistent with the increasing of the short circuit current density (J_{sc}), as well as of the power conversion efficiency (PCE). The maximum PCE of the device reached 3.77% which was ~10% higher in PCE using the most conductive polymer PP(1:2.5)-12. Increasing the ratio of PSS for samples PP(1:2.5)-12, PP(1:3)-24 to PP(1:5)-24 (1:2.5, 1:3 to 1:5) does not affect the device performance substantially. Adjusting the processability of the PEDOT/PSS by adding concentration of PSS can be done without affecting the PCE in this ratio, but with a little change in the fill factor (*FF*) or value of open circuit voltage per current density (V_{oc}/J_{sc}).

Keywords: *PEDOT/PSS, OPV, power conversion efficiency (PCE), fill factor*

I. INTRODUCTION

PEDOT is a highly conducting polymer and a valuable organic electronic material. PEDOT is insoluble in many solvents but can be dispersed in water in the presence of polystyrene sulfonate (PSS) as the doping agent (Fig. 1). Among the polythiophenes, poly(3,4-ethylenedioxythiophene) or PEDOT, has been attracting specific attention including its methods of synthesis. Processable PSS doped PEDOT resulted in films with several advantageous properties such as a low oxidation potential, moderate band gap with very good stability in the doped state, and excellent environmental stability.[1, 2] A minimal change of conductivity can be seen in PEDOT/PSS film after heating at 100^{o}C in air for over 1000 h.[3] These properties make processable PEDOT a popular choice as a conductive material for the fabrication of electronic devices.

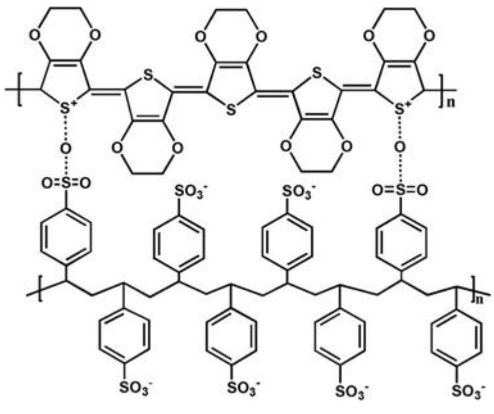

FIGURE 1. PRIMARY STRUCTURE OF PEDOT/PSS COMPLEX.[4]

PEDOT was developed by scientist at the Bayer AG research laboratories in Germany since the 1980s. This polymer was initially found as an insoluble polymer, however PEDOT is highly conductive polymer (ca. 300 S/cm), and was found as almost transparent in thin, oxidized films and showed very high stability in the oxidized state by electrochemical measurements.[5, 6] The low solubility of PEDOT is solved by using another polyelectrolyte, poly(styrene sulfonic acid) or PSS, which is soluble in water, as the charge balancing dopant during polymerisation.

PSS is a linear polyelectrolyte with a high negative charge, and the PSS content in the system of PEDOT/PSS impacts on some typical properties such as conductivity, transparency, and stability films.[2] Further study reflects that increasing the PSS content logically will reduce the electric conductivity.[4, 7] PEDOT/PSS ratio of 1:2.5 has higher conductivity compared to the PEDOT/PSS ratio 1:6 which is also more conductive than films from PEDOT/PSS ratio 1:20.[4, 7] These conductivity values are associated with the solid content of the polymer system and correlated to their applications. Therefore, PEDOT/PSS ratio 1:2.5 is suitable for antistatic applications, ratio 1:6 is suitable for OLEDs, and ratio 1:20 is suitable for passive matrix displays.[4]

Various additives have been used as a means of achieving enhanced conductivity of PEDOT/PSS films, such as by adding HCl-methanol treatment[8], adding organic solvent additives and annealing[9-11], and using DMSO or ethylene glycol so the conductivity can reach 900-1000 S/cm[12]. Recent enhancement of the conductivity of PEDOT/PSS films 1880 times that of pristine film was achieved by adding dimethyl sulphate[13], and more 2000 S/cm by adding ionic liquid[14], and even more than 3000 S/cm after treatment using H_2SO_4[15], comparable to that of indium tin oxide (ITO) as a transparent electrode material in some devices applications. Ouyang, et al (2013) described the used of some additional dopants to PEDOT/PSS dispersions.[16]

II. METHODE

A. Materials and Reagents

Commercial PEDOT/PSS (Clevios, 1:2.5 ratio, P VP AI 4083), with a solid content of 1.3 - 1.7% by weight was purchased from H.C. Starck (Munich, Germany), and stored in a refrigerator at 5^{o}C until it was used. Poly(styrene sulfonate) (PSS, MW = 70 kDa) and poly(4-vinylpiridine) (PVPy) were purchased from Sigma-Aldrich Australia and used as received. Poly(3-hexylthiophene) (P3HT) was purchased from Rieke Metals Inc, Nebraska USA (*M*w = 60K, PDI = 2.1, RR = 91-95%) and Luminescence Technology Corp., Taiwan (*M*w = 58-63K, PDI = 3.6, RR = 93- 95%) and stored under nitrogen. (6,6)-Phenyl-C_{61}-butyric acid methyl ester (PCBM) (99.5 % purity) was purchased from Luminescence Technology Corp., Taiwan and stored under nitrogen.

Glass microscope slides were purchased from Livingstone and cut into 12 mm x 15 mm. Indium tin oxide (ITO) coated slides (Rs = 8-12 Ω) were purchased from Delta Technologies Limited. Pre-patterned ITO slides (Rs = 15 Ω/sq, 13 mm x 18 mm x 1.1 mm) ITO coated glass (XY 15S) double ended were purchased from Kintec Company, Hong Kong.

B. Preparation of PEDOT/PSS Aqueous Dispersions

The general procedure for the synthesis of all PEDOT/PSS aqueous dispersions was as previously described by Louwet, et, al.[1] Typically, 192.3 mg of 3,4-ethylenedioxythiophene was mixed with the appropriate volume of 6 wt % PSS solution to obtain the desired PEDOT:PSS ratio by weight (e.g. 8.00 mL of 6 wt % PSS = 481 mg PSS for a 1:2.5 ratio). 384 mg of $Na_2S_2O_8$ initiator was then added and the reaction mixture made up to 30.0 mL with RO water. After stirring for 10 minutes, 3 mg of $Fe_2(SO_4)_3$ was added and the reaction mixture was stirred vigorously for the required time of reaction. The dark blue aqueous mixture is purified by stirring (ion exchanging) with acidic and basic ion exchange resins (~500 mg) for about 10 minutes then dialysed in methanol and water to remove unreacted monomers and oxidation agents.

C. Fabrication and Testing of an Organic Photovoltaic Device

A typical organic photovoltaic (OPV) cell device in this project consists of a thin film (~100 nm) of photoactive material sandwiched between two electrodes. The devices are built onto a glass substrate in layers. The glass slides were purchased with pre-patterned ITO with 5 mm^2 active area. The pre-patterned ITO slides allow for six pixels of 3x15 mm defined by chemical etching to be made on each slide. The slide-surface was pre-coated with a protective photoresist to keep the active surface from contamination. The first step in the fabrication process is the removal of this protective layer by sonicating the slides in a 5% NaOH solution before rinsing them in an aqueous detergent solution for 30 min at ~40^{o}C in an ultrasonic bath (Unisonix FXP10M). The glass slides were then rinsed repeatedly with milli-Q water, sonicated in acetone and in isopropyl alcohol (IPA), and dried with lint-free tissue (Kim Wipes®), then blown-dry in dry nitrogen gas.

All PEDOT/PSS aqueous dispersions were sonicated for 30 minutes to break the aggregation and followed by filtration using 0.45 um PVDF filter. The active layer P3HT/PCBM solution was freshly prepared using P3HT (MW2121B) (having a Mw ~60kDa characteristic) and PCBM purchased from Lumtec with a weight ratio of 1:0.8. The solution was made of 18 mg mixed P3HT/PCBM in 1 mL chloroform in 4 mL vial. The solution was then placed in an ultrasonic bath for between 30 mins and 90 mins to completely dissolve each component and to obtain a homogeneous solution.

Typically, the ITO substrates were secured in the ozone cleaner (UV/Ozone Procleaner TM, BIOFORCE NANO SCIENCES) for a minimum of 15 min prior to use. The general schematic of an OPV device can be seen in Fig. 2. PEDOT/PSS film was deposited onto the substrate by spin coating 75μL of the PEDOT/PSS dispersion to form a thin film (~50 nm thick). The spin-coater (Laurell WS-400A-6nPP/LITE) was adjusted to 4000 rpm for 1 min. The ITO substrate contacts were cleaned with a dry cotton tip soaked in water to remove PEDOT/PSS covering the ITO contacts, the samples were then annealed at 140^{o}C for 15 min. The active layer P3HT/PCBM was also deposited on top of the PEDOT/PSS layer by spin coating 65μL of P3HT/PBM solution at 2000 rpm for 1 min using acceleration 1680 rpm/s in the glove box. Again, the excess polymer covering the ITO contacts was wiped out with a dry cotton tip soaked in chloroform.

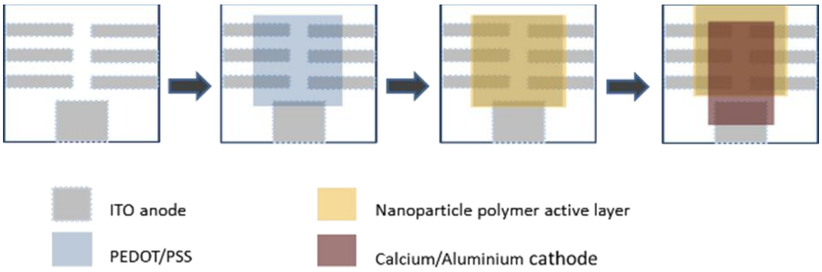

FIGURE 2. SCHEMATIC OF THE OPV DEVICE

The next step is cathode deposition which was performed through a shadow mask. Typically, calcium (20 nm) was deposited followed by aluminium (100 nm) to the slide and in contact with the bottom electrode to complete the circuit. The resulting solar cell device forms six electrically insulated ITO fingers acting as six separate anodes, means six separate solar cells on each slide, with a common calcium/aluminium cathode. All steps of device fabrication were performed in a nitrogen atmosphere in a glove box to prevent device degradation by the presence of water and oxygen.

The performance of an OPV device can be determined by the I-V characteristic testing or I-V curve. The I-V curve data can be used to calculate the power conversion energy (PCE) of the device, and other parameters. The important parameters that can be analysed from this curve are the short circuit current, I_{sc} (or current density, J_{sc}) and open circuit voltage (V_{oc}). These parameters can be used to calculate the fill factor (*FF*) and PCE of the device.

III. RESULTS AND DISCUSSIONS

A. *Performance of Organic Photovoltaic Device*

In general, organic photovoltaic cell or organic solar cells have some advantages compared to conventional (inorganic) solar cells. They have the potential to be flexible and transparent films, and can be manufactured using printing processes as well as produced in large area. In addition, organic materials are also easier to apply in various devices, and also important is the substantial economic advantage due to low cost and environmental advantages.[17, 18] The efficiency of the solar cell defines the competition between the use of inorganic and organic solar cells. High efficiency and long life times can be achieved by inorganic solar cells compare to organic solar cells, but they also are more expensive. Current organic solar cells are not expensive to fabricate, but they have lower efficiency and lifetime. Therefore, achievement of high efficiency and lifetimes are needed in the research of organic solar cell.

The mechanism in organic solar cells has a few different characteristics to inorganic solar cells. Some differences while operating these devices are based on the energy level, dissociation energy, charge carrier mobility, and coefficient light absorptions.[19] Nevertheless, the efficiency of the conventional solar cell, such as silicon photovoltaic cell, can reach 20%, whereas the organic solar cell based on the concept bulk hetero junction can operate at 3.0-3.5% efficiency[20], Liang could reach 7.4%[21], and the latest result reported an efficiency of 12%[22].

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The work on solar cell research and device development has focussed especially on the bulk hetero junction layer, and more investigation to optimise interface between phases of the device is needed. The ideal polymers in bulk hetero junction solar cell should provide a broad absorption and high coefficient across the solar spectrum. They also need high hole mobility, energy level matching fullerene and must be compatible to form a bicontinuous network on the nano scale. These considerations have a large contribution to determining better performance of OPV devices.[23] The active layer in the bulk hetero junction concept consists of two materials as a donor and an acceptor electron. The donor and acceptor electron materials in the active layer represent an ideal bicontinuous composite, which will optimise the all-important interfacial area between the donors and acceptors.[24] One material is a conducting polymer that acts as the hole transport, or p-type material, and another material should act to accept and transport electron (e.g. fullerenes), and is known as n-type material. Both different materials in the active layer of the device are used to improve the optical density. Positive and negative charges are generated simultaneously in this layer. The four fundamental steps in the mechanism: light absorption and exciton generation, exciton diffusion, exciton diffusion and charge transfer, and charge transport and charge collection.

The OPV device consists of at least four layers on the top of the substrate. The basic schematic of an organic photovoltaic device is shown in Fig. 3. At the top of the substrate is indium tin oxide (ITO), which is a popular cathodic material due to its transparency. ITO precoated onto a glass substrate is also commercially available. The conductive polymer layer, which is generally a mix of PEDOT/PSS, can be placed between the cathode and the active layer. Two common materials used in the active layer, among others, are poly(3-hexylthiophene) or P3HT as the donor electron, and (6,6)-phenyl-C_{61}-butyric-acid methyl ester or PCBM as the acceptor electron. These materials are popular as model systems in bulk hetero junction for the organic solar cell.[18] The chemical structure of P3HT and PCBM can be seen in Fig. 4. The last layer is the anode, typically made of aluminium, calcium, silver, or gold, and it is deposited on the top of active layer.

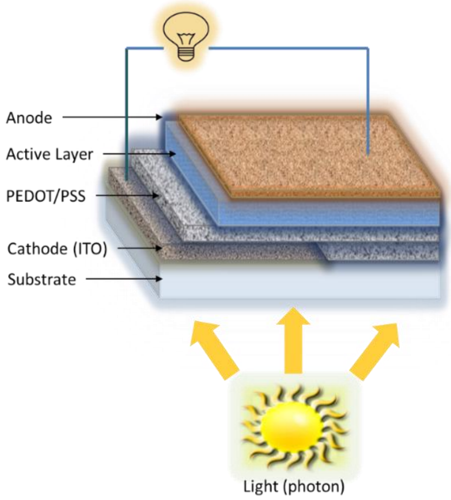

FIGURE 3. SCHEMATIC DEVICE STRUCTURE OF AN ORGANIC PHOTOVOLTAIC CELL.

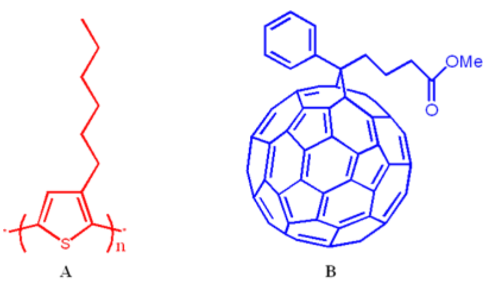

FIGURE 4. THE CHEMICAL STRUCTURES OF (A) P3HT, AND (B) PCBM.

B. Characterising Organic Photovoltaic Device

In characterising a typical bulk heterojunction solar cell, a graph for dark and light current (*I*) versus voltage (*V*), known as current-voltage (*I-V*) curves, which define the primary quantities need to validate the performance of a solar cell device, is usually used.[24] The current-voltage curve passes through the origin, when there is no current passing through the device, and no potential is detected. But when the device absorbs light, the curve will shift downward indicating current passing through the device (see Fig. 5). Some terminologies are used to define organic solar cells. The main parameters measured from the *I-V* curve are the short circuit current density (J_{sc}), or sometimes short circuit current (I_{sc}) is issued, and open circuit voltage (V_{oc}), which can be used to calculate the fill factor (*FF*) and power conversion efficiency (PCE) of the device. Short-circuit current density (J_{sc}) is the maximum current produced by the illuminated device area when there is no external load. Open-circuit voltage (V_{oc}) is the maximum possible voltage across the device when no current is flowing. J_{max} and V_{max} are the current and voltage at the maximum power point. Fill-factor (*FF*) is the ratio of the maximum power output of the device, and it is a key quantity in measuring solar cell performance. The efficiency (η) or PCE is calculated by the ratio of the output electrical power (power out, P_{out}) to the incident optical power (power in, P_{in}). PCE measures the amount of power produced in the device relative to the available power from radiation, and is generally standardized as 100 W/cm^2 in solar simulator.[20]

Other terminologies in characterising solar cell efficiency are air mass (*AM*), and quantum efficiency (*QE*). Air mass defines the quantity of sunlight irradiated at the surface of the earth. A typical value for solar cell measurement is AM 1.5 illumination, which means the sun is at an angle of about 48^o. *QE* is an efficiency of energy or wavelength irradiation in the device. *QE* can be divided as an external quantum efficiency (*EQE*), the ratio of the number collected carriers to the number of incoming photons, and internal quantum efficiency (*IQE*), the ratio of the number collected carriers to the number of photons absorbed.[19, 20]

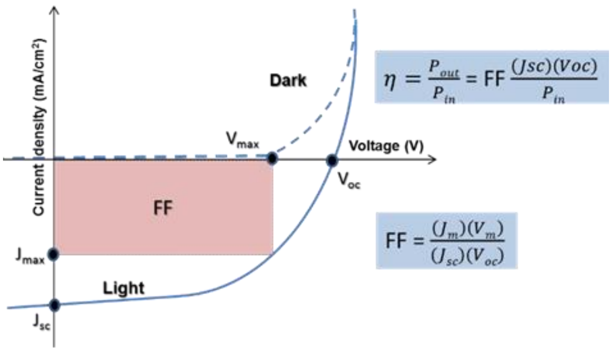

FIGURE 5. A GRAPH OF CURRENT VERSUS VOLTAGE FOR A SOLAR CELL.

Energy conversion or power conversion efficiencies (η) of the OPV device are based on a number of variables: the light absorption of the electron donor-acceptor materials, the transport of excitons from both materials to the donor-acceptor interface, the efficiency of the exciton separation breaking up into electron-hole pairs at the interface, transport of holes across the donating layer to the anode, and transport of electrons across the acceptor layer to the cathode. In addition, it also depends on the quality of contact between the donor layer and the anode, and between the acceptor layer and the cathode.[25]

C. OPV Device Performance Fabricated Using In-House PEDOT/PSS Dispersions

PEDOT/PSS films as a conductive polymer layer in the solar cell device are placed between the cathode and the active layer. The comparison of the properties between synthesised and commercially-sourced PEDOT/PSS aqueous dispersions has already been discussed in the previous papers[26]. In terms of processability, all synthesised PEDOT/PSS samples have good film morphology and are homogeneous and uniform. They have different charge mobilities which are related to their conductivity. The more conductive film exhibits slower electrophoretic mobility due to higher doping of PEDOT with PSS in their complexes.[27] Increasing the amount of PSS in the dispersion makes the PEDOT/PSS dispersion more processable, but typically lower conductivity.

The more conductive synthesised PEDOT/PSS films were applied to OPV device fabrication. Table 1 shows a summary of the device performance after characterisation. Reading the PCE of all devices, all samples with the exception of PP(1:2.5)-12, have PCE within the experimental error of the PCE commercial PEDOT/PSS. The tendency of increasing conductivity is not consistent with the increasing of the J_{sc}, as well as of the PCE. Increasing the ratio of PSS for samples PP(1:2.5)-12, PP(1:3)-24 to PP(1:5)-24 (1:2.5, 1:3 to 1:5) does not affect the device performance substantially. This means that adjusting the processability of the PEDOT/PSS by adding concentration of PSS can be done without affecting the PCE in this ratio, but with a little change in V_{oc}/J_{sc} or *FF*. The main exception is in the performance of device from PP(1:2.5)-12 sample, which is the most conductive film (its conductivity is ~542 times than PP(1:2.5)-C), and generates a device ~10% higher in PCE. The device containing PP(1:2.5)-12 film also showed no real change in V_{oc}, but J_{sc} increases by more than 30%, while *FF* drops by ~30% at the same time. This performance suggests that highest conductivity material has an increase in J_{sc} which must be due to the lowered resistivity of this interfacial layer.

TABEL 1. SUMMARY OF THE PERFORMANCE PARAMETERS OF THE PHOTOVOLTAIC DEVICE.

PEDOT/PSS	σ (S/cm)	V_{oc} (mV)	J_{sc} (mA/cm^2)	*FF*	PCE (%)	PCE max. (%)
PP(1:2.5)-C	9.6±1.0E-3	606.8±8.8	-8.14±0.49	0.62±0.06	3.06±0.38	3.54
PP(1:2.5)-12	5.2±0.7E-0	595.5±3.9	-13.26±1.20	0.42±0.03	3.30±0.36	3.77
PP(1:3)-24	2.7±0.9E-1	589.6±22.9	-8.35±0.32	0.55±0.04	2.70±0.23	2.93
PP(1:5)-24	1.5±0.5E-1	597.2±4.4	-8.20±0.28	0.56±0.03	2.72±0.17	2.94

Inconsistency of the OPV performance with increasing conductivity of PEDOT/PSS film can be exhibited from the I-V curve of those devices. Fig. 6 shows that the I-V curve of both PP(1:2.5)-C and PP(1:2.5)-12 are similar in V_{oc}, but their J_{sc} are different and the *FF* for the device of PP(1:2.5)-12 is also much worse. PP(1:3)-24 and PP(1:5)-24 which have higher concentrations of PSS and lower conductivity than PP(1:2.5)-12 start with about similar density current but lower FF. The worse FF in PP(1:2.5)-12 device is not just because of recombination process of exciton, but higher serial resistance and lower shunt resistance largely affect this performance. More recombination of excitons in the active layer is possibly occuring resulting to a lower efficiency of the device performance. Notably, the FF of these devices is systematic, with the highest value obtained from the PEDOT/PSS with the lowest conductivity, and the lowest value from the most conductive PEDOT/PSS. This possibly reflect the inability of the higher conductivity PEDOT/PSS to act as an effective electron blocking layer in the device and warrants further investigation.

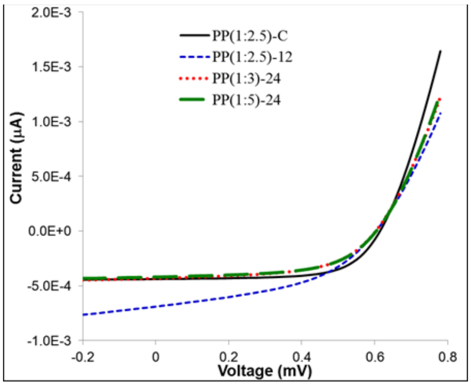

FIGURE 6. I-V CURVES OF OPV DEVICE USING PP(1:2.5)-C, PP(1:2.5)-12, PP(1:3)-24 AND PP(1:5)-24 AS THE INTERFACE LAYER.

Consequently, the use of highly conductive PEDOT/PSS as an interface layer in OPV's maybe counter productive, since the material will be less effective as an electron blocking layer (FF) and will draw current from outside the device area. The observation that these devices draw current from such a large region outside the device (the PCE is tripled) is interesting, and points to the use of high conductivity PEDOT/PSS as transparent electrode material in these devices eliminating the need for ITO.

IV. CONCLUSSIONS

All synthesised PEDOT/PSS dispersions have shown comparable OPV and OFET devices to the commercial PEDOT/PSS dispersion. In particular, in the case of the OPV device, the synthesised PEDOT/PSS dispersions showed similar results to the commercial PEDOT/PSS, except for the most conductive material which has larger "efficiency" when it is not masked. Higher conductivity of PEDOT/PSS films leads to a lower *FF* but also draws charge from outside the device area. The most important point here is the possibility to produce PEDOT/PSS with higher concentrations of PSS which will generate devices similar to the commercial PEDOT/PSS but with better FF's. Clearly the amount of free PSS is important in OPV application – in OPV's the PSS affects the FF of the device. The amount of free PSS in the dispersions which governs the processability of the films is a variable that can be adjusted to change the characteristics of this device towards optimum performance.

ACKNOWLEDGMENT

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C – 02

Chitosan-Key Lime Film for Food Preservation

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Abstract**—**In the present work, environmental friendly films were prepared by incorporating key lime (*Citrus aurantifolia*) extract to chitosan biopolymer. The chitosan-key lime (CKL) films were synthesised using two concentrations of key lime, namely 25% and 50% (v/v). The physical and chemical properties of CKL films were characterised using several analytical instruments such as Fourier Transform Infrared Spectrometer (FTIR), UV-Visible Spectrophotometer (UV-Vis), Scanning Electron Microscope (SEM), Differential Scanning Calorimeter (DSC) and Universal Testing Machine. The addition of key lime extract reduced the transparency value of biopolymer films. A pronounced effect was obtained for CKL 50% (v/v) film, of which the opacity value was decreased from 1.06 (chitosan film) to 0.54. The elongation at break of the films was increased from 13.34% (chitosan film) to 76.06% (CKL 25% v/v) and 154.69% (CKL 50% v/v), respectively. Meanwhile, the tensile strength of the films was decreased from 34.09 MPa (chitosan film) to 10.28 MPa (CKL 25% v/v) and 3.02 MPa (CKL 50% v/v), respectively. Gram-positive bacteria (*Staphylococcus aureus*) and Gram-negative bacteria (*Escherichia coli*) were used to test the antimicrobial activity of the films. The CKL films had a superior antimicrobial property against *S. aureus* and *E. coli* as compared to chitosan film. Based on preservation study, CKL films were able to control the weight loss and browning index of cherry tomatoes. Overall, results from this study suggest that CKL films have great potential to preserve food products.

Keywords: *biopolymer film, chitosan, food preservation, key lime*

I. INTRODUCTION

One of the challenges in food industry is related to the packaging of food products with a short shelf-life period [1]. Although conventional packaging materials such as plastics and their derivatives are effective to preserve food products, they create serious environmental problems that continue to present the food industry as a source of pollution [1,2]. For this reason, all stakeholders in food industry as well as scientists specialising in the food engineering and packaging are required to seek alternatives to overcome this serious problem.

In recent years, there is a growing interest in food industry primarily on product innovation that satisfies consumers' demand for high quality and healthy food products. A preference for food products with natural instead of synthetic additives is also significantly related to health concerns [3]. Edible films from biopolymers offer an application of the active food packaging [4]. Biopolymers can be used as vehicles for additives like antioxidant and/or antimicrobial agents, vitamins, flavours and pigments [5]. This will improve the quality and increase the shelf-life of the foods.

In this context, chitosan (β-(1.4)-2-amino-2-deoxy-ᴅ-glucose) has attracted much attention. Chitosan has excellent film forming properties, and derives from chitin, the second most abundant natural polymer in nature after cellulose [6]. It is normally produced from waste bio-products of shellfish industry. Chitosan can also be obtained from the chitin component of fungal cells walls [7]. Chitosan has cationic groups along its backbone, which has been shown to have antimicrobial properties against bacteria, yeasts, mould and fungi [1,6,7]. In addition, chitosan posses several unique properties such as biodegradability, biocompatibility, non-toxicity and it is renewable [7].

Chitosan can be applied in two forms, namely coatings and films [7]. The formulation of chitosan coatings and films usually involve acetic acid as a solvent. The use of acetic acid even at low concentration (1% v/v) will produce an unpleasant smell. This scenario has reduced its application in food preservation. Therefore, this research was devised as a direct response to the aforementioned issue. We hypothesised that key lime (*Citrus aurantifolia*) extract can be used as an alternative to acetic acid, producing both environmental and user friendly films for food preservation.

II. MATERIALS AND METHODS

A. Chemicals

Chitosan with low molecular weight (85% degree of deacetylation) was purchased from Sigma-Aldrich. All other chemicals were of analytical grade obtained from Merck and Fisher Scientific. Key lime (*C. aurantifolia*) was purchased from a local market. Deionised water was used for the experiments.

B. Preparation of Chitosan and Chitosan-Key Lime Films

Films were prepared using casting procedure. Exactly 100 mL of acetic acid (1% v/v) was added to 2 g of chitosan powder. The mixture was stirred and heated at 60 ºC for 30 min using a magnetic stirrer to avoid lumps and obtain homogeneous solution. The solution was underwent vacuum for 20 s to eliminate bubbles and poured onto disposable polystyrene petri dishes (85 mm x 15 mm). Petri dishes were left to cool for 30 min at room temperature and air-dried in a convection oven at 40 ºC for 24 h. The films obtained were cooled at room temperature, carefully peeled from petri dishes and stored in a vacuum desiccator.

The chitosan-key lime (CKL) films were prepared using a similar procedure for preparation of chitosan film. For this purpose, exactly 100 mL of key lime extracts (25% and 50% v/v) were added separately to two sets of 2 g of chitosan powder. The mixtures were stirred, heated and dried in an oven as described earlier. The films obtained were kept in a desiccator until ready for analysis.

C. Characterisation Studies

Several analytical instruments such as Fourier Transform Infrared Spectrometer (FTIR), UV-Visible Spectrophotometer (UV-Vis), Scanning Electron Microscope (SEM), Differential Scanning Calorimeter (DSC) and Universal Testing Machine (UTM) were used to characterise the physical and chemical properties of chitosan and CKL films.

The FTIR spectra of the films were recorded in the wavenumber range between 4000 and 400 cm^{-1} with over 25 cumulative scans using a Thermo Nicolet 6700 FTIR.

The transmission of UV and visible light in each film was recorded from 200 to 800 nm using an Agilent Cary 60 UV-Vis. The transparency of the film was calculated using the following equation [8]:

$$\text{Transparency (A/mm)} = \frac{-\log \mathrm{T}}{x}$$

where A is the absorbance at wavelength 600 nm, T is the transmittance (%) at wavelength 600 nm and x is the film thickness (mm).

The surface morphology of the films was observed using a Hitachi SU 8020 UHR SEM. The films were first coated using platinum to avoid charging.

The thermal stability of the films was studied using a PerkinElmer Diamond DSC. The films were heated within temperature range of -10 to 600 ºC at a rate of 10 ºC/min under a nitrogen flow.

The tensile strength and elongation at break of the films were determined using an Instron 5067 UTM.

D. Antimicrobial Properties

The antimicrobial activity of chitosan-key lime films was determined by the agar disc diffusion method against Gram-positive bacteria (*Staphylococcus aureus*) and Gram-negative bacteria (*Escherichia coli*). Bacteria were incubated at 37 ºC for 24 h. After incubation, the inhibition area which considered as a measure of the antimicrobial activity will be measured.

E. Preservation Study

Fresh cherry tomatoes were used in this study. Three cherry tomatoes were randomly selected, washed using deonised water and dried. The weight of each cherry tomato was measured. The fruits were then wrapped using the key-lime films and kept at room temperature. Two equations, namely weight loss (%) and browning index are involved in preservation study.

The weight loss (%) was calculated using the following equation [9]:

$$\text{Weight loss (\%)} = \frac{(W_i - W_f)}{W_i} \times 100$$

where W_i and W_f are the initial and final weights of the fruits, respectively.

The browning index was calculated using the following equation [10]:

$$\text{Browning index} = \frac{\sum(\text{Browning level})\ x \text{ number of fruit at the browning level}}{\text{Total number of fruit in the treatment}}\ x100$$

III. RESULTS AND DISCUSSION

A. Characterisation Studies

FTIR Analysis

In this study, FTIR analysis was performed in order to determine the chemical structure of chitosan and CKL films. The FTIR spectra of chitosan and CKL films are shown in Figure 1. From Fig. 1(a), chitosan shows characteristic peaks at 3368 cm^{-1} (-OH and –NH_2 stretching), 2873 cm^{-1} (-CH stretching), 1632 cm^{-1} (amide I), 1550 cm^{-1} (amide II), 1409 cm^{-1} (CH_3 symmetrical stretching band) and 1075 cm^{-1} (C-O-C asymmetric stretching) [11].

Following reaction with key lime extracts, the -OH and –NH_2 band was shifted from 3368 to 3396 cm^{-1}, while the –CH band was shifted from 2873 to 2920 and 2933 cm^{-1} (Figs. 1(b) and 1(c)). A similar observation was reported by Aresta et al. [12]. They reported that the broad band which represents –OH and –NH_2 groups was shifted from 3410 to 3310 cm^{-1} after incorporation of ascorbic acid into chitosan nanoparticles. A new absorption band was observed at 1715 cm^{-1}, which corresponds to C=O stretching. It is known that limes are an excellent source of ascorbic acid ($C_6H_8O_6$) [13]. Therefore, the appearance of C=O stretch at 1715 cm^{-1} can be related to the presence of ascorbic acid in the CKL films. Interaction of chitosan and key lime extract has led to combination of the absorption bands of amide I (1632 cm^{-1}) and amide II (1550 cm^{-1}), producing a new absorption band at 1617 cm^{-1}. The CH_3 stretching band was shifted from 1409 cm^{-1} to 1393 cm^{-1} with a significant reduction in absorption intensity. In contrast, the wavenumber of C-O stretch band was shifted from 1150 cm^{-1} to 1216 cm^{-1} with a considerable increase in absorption intensity.

Overall, the change in wavenumber and absorption intensity could be attributed to interaction between –OH and –NH_2 groups of chitosan and –OH and C=O groups of ascorbic acid. In general, the aforementioned functional groups are capable of forming hydrogen bonds [14].

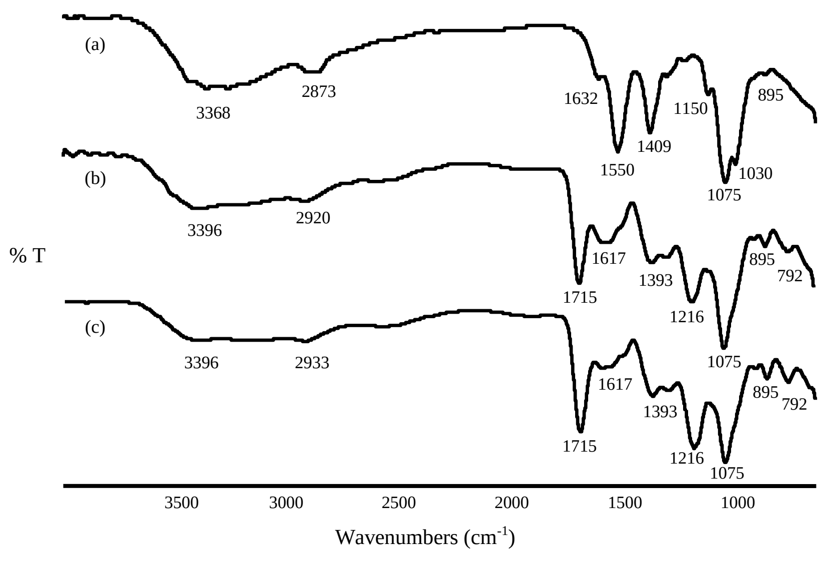


FIGURE 1. FTIR spectra of (a) Chitosan, (b) CKL 25%, and (c) CKL 50%.

UV-Vis Analysis

Transparency of films is important due to their great impact on the appearance of the food products [2,15]. Since consumers prefer to see foods, higher transparency would have an advantage. Light transmission and transparency of chitosan and CKL films at selected wavelength are given in Table 1. The transmission of UV light in chitosan and CKL films was very low at 200-280 nm. In fact, it was negligible at 200 nm. This suggests that the films have excellent UV barrier properties, which induces lipid oxidation in the food system [1,15].

As shown in Table 1, the transmission of visible light was between 8.35 to 82.84% at 350-500 nm, and was greater than 80% at 600-800 for all films. In visible range (350-800 nm), both CKL films (25 and 50% v/v) exhibited lower light transmission than the chitosan film (control). The addition of key lime extract to chitosan reduced the transparency of CKL films. The opaque appearance of the CKL films reflects the visible light, thereby hinders light transmission through the films. The transparency value (A/mm) decreased from 1.06 (chitosan film) to 0.79 (CKL 25%) and 0.54 (CKL 50%), respectively. The transparency of films was greatly affected by concentration of key lime extract, of which higher concentration caused greater reduction in transparency. The effect of extract lime on reducing the transparency of chitosan film is similar to the effect of cellulose nanoparticles on transparency of hydroxypropyl methylcellulose (HPMC) films [16]. The transparency value of chitosan film obtained from this study was higher than those reported by Hosseini et al. [8] for chitosan (0.95 A/mm) and gelatin (0.56 A/mm) films, respectively.

TABLE 1. Light transmission (%) and transparency of chitosan and CKL films.

Film	Light transmission at different wavelength (%)							Transparency (A/mm)
	200	***280***	***350***	***400***	***500***	***600***	***800***	
Chitosan	0.04	21.96	46.94	70.3	82.84	86.39	88.93	1.06
CKL 25%	0.02	4.52	19.04	47.66	79.54	85.72	87.99	0.79
CKL 50%	0.01	2.14	8.35	15.89	64.13	84.35	85.11	0.54

SEM Analysis

The morphology and homogeneity of the matrix affect the permeability of a film [17]. SEM analysis was carried out to understand the effect of key lime extract on surface morphology of chitosan film. The SEM images of chitosan and CKL films are shown in Fig. 2. From Fig. 2, chitosan and CKL films display a smooth and homogeneous surface texture, without pores. When viewed the films at 5 μm, there was no significant different between chitosan and CKL films. In fact, the application of key lime extract at different concentrations produced a similar surface texture (Figs. 2(b) and 2(c)). This implies that concentrations of key lime did not influence the surface morphology of the films.

Depending on physical and chemical properties of the biopolymer and additives, the addition of additives may alter the surface morphology of biopolymer film. For example, Shittu et al. [18] observed a significant change in surface texture of chitosan film when pseudoboehmite alumina (BAH) was added at three rates, namely 1, 2 and 3 % (w/w). They reported that an increase in BAH content reduced the surface smoothness, as well as the formation of holes and crack texture on the surface of chitosan film. Hosseini et al. [15] studied the effects of chitosan nanoparticles addition on surface morphology of chitosan film. The application of chitosan nanoparticles at 2% (w/w) was reported to produce a composite film with a smooth and good particles distribution, as well as without formation of aggregates. No significant difference was reported when compared with chitosan film.

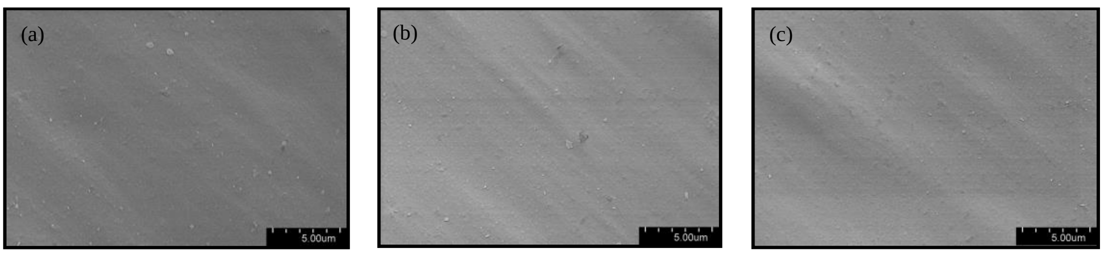


FIGURE 2. SEM images of (a) Chitosan, (b) CKL 25%, and (c) CKL 50%.

DSC Analysis

The changes of the thermal properties of chitosan film as a result of key lime extract incorporation were studied using DSC. The DSC thermograms of chitosan and CKL films are shown in Fig. 3. From Fig. 3(a), chitosan showed characteristic of weak exothermic peak at 151 °C and endothermic peak at 299 °C. Interaction of chitosan with key lime extract at 25 and 50% (v/v) concentrations has caused the exothermic peak at 151 °C to shift to 175 and 165 °C (Figs. 3(a) and 3(b)), respectively. This scenario could be attributed to formation of hydrogen bond between ascorbic acid and polymeric network of chitosan. A similar observation was obtained for chitosan-Vitamin C film studied by Aresta et al. [12]. The temperature for exothermic peak was shifted to a higher temperature following incorporation of Vitamin C into chitosan.

A significant change in thermal properties of chitosan was obtained when key lime extract was added at concentration of 50% (v/v). From Fig. 3(c), the DSC thermogram of CKL 50% (v/v) film exhibited a characteristic of exothermic at 165 °C, and three endothermic peaks at 139, 226 and 340 °C. This finding suggests that the thermal properties of chitosan were greatly influenced by concentration of key lime extract. The change in crystalline structure and thermal stability of chitosan would alter the permeability of chitosan film.

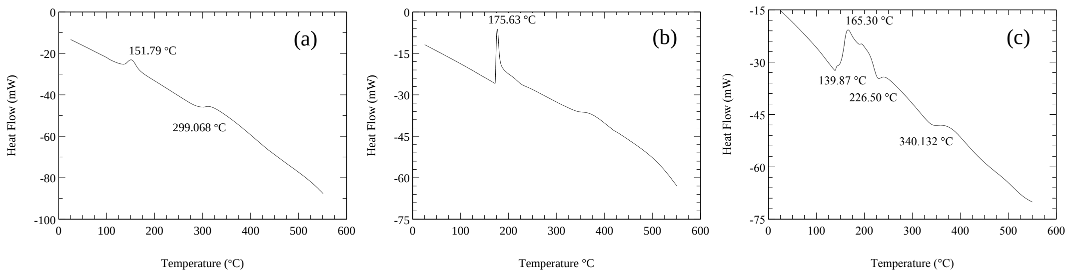


FIGURE 3. DSC thermograms of (a) Chitosan, (b) CKL 25%, and (c) CKL 50%.

Mechanical Properties

Adequate mechanical strength and extensibility are key criteria for a packaging film [7,17]. Table 2 presents the percentage of elongation at break (% EAB) and tensile strength of chitosan and CKL films. The EAB of chitosan increased with addition of key lime extract. In fact, an increase in concentration of key lime extract had significantly increased the EAB of the films. A pronounced effect was obtained for CKL 50% film, of which the EAB was increased from 13.34% (chitosan film) to 154.69%. A lesser effect was observed for CKL 25%, with an increment of 62.72%. In contrast to EAB, the TS value (MPa) decreased from 34.09 to 10.28 and 3.02 for CKL 25% and CKL 50%, respectively. A similar trend of reduction was obtained by Pereda et al. [19]. They reported that the TS value for chitosan-bovine gelatin reduced with an increase in amount of bovine gelatin. Based on mechanical properties study, it can be concluded that the strength and flexibility of the chitosan-key lime films could be modified by changing the concentration of key lime extract.

TABLE 2. Elongation at break (EAB) and tensile strength (TS) of chitosan and CKL films.

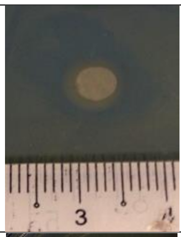
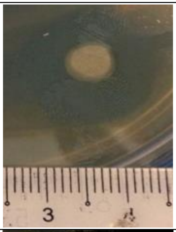
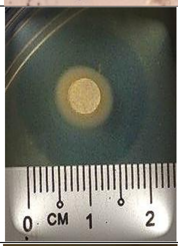
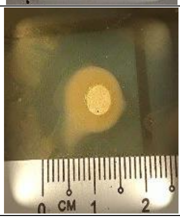
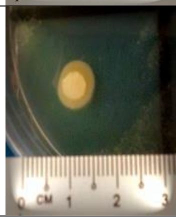
Film	**EAB (%)**	**TS (MPa)**
Chitosan	13.34	34.09
CKL 25%	76.06	10.28
CKL 50%	154.69	3.02

B. Antimicrobial Properties

Antimicrobial film is important for active packaging systems that have been found highly effective in killing or inhibiting spoilage and pathogenic microorganisms that contaminate foods [20]. The antimicrobial activity of chitosan and CKL films was assessed using Gram-positive bacteria (*S. aureus*) and Gram-negative bacteria (*E. coli*). The inhibition zone of the films against *S. aureus* and *E. coli* was calculated based on the formation of bacterial inhibition zone around the test films, which is given in

Table 3. The addition of key lime extract improved antimicrobial property of chitosan. A significant inhibition effect was observed on *S. aureus*, of which the inhibition zone was increased from 7 mm (chitosan film) to 9 mm (CKL 25%) and 11 mm (CKL 50%), respectively. A slight increase in the inhibition zone was observed for *E. coli*, of which it was increased from 5 mm (chitosan film) to 7 mm (CKL 25%) and 8 mm (CKL 50%), respectively. Results suggest that an increase in concentration of key lime extract would enhance the antimicrobial activity of chitosan film. It is interesting to note that natural additive like key lime extract can be an alternative to synthetic additives for controlling food pathogens.

TABLE 3. Inhibition zone of chitosan and CKL films against *S. aureus* and *E. coli*.

Film	***S. aureus***	**Inhibition zone (mm)**	***E. coli***	**Inhibition zone (mm)**
Chitosan		7		5
CKL 25%		9		7
CKL 50%		11		8

C. Preservation Study

The effectiveness of chitosan and CKL films to preserve food was evaluated in a preservation study using cherry tomatoes. Unwrapped fruits were used as controls in this study. The changes in the appearance and fruit freshness were monitored in naked eyes. After 14 days of preservation study, the weight loss and browning index of cherry tomatoes were determined, which are presented in Table 4. From Table 4, it is clear that wrapping fruits with chitosan and CKL films reduced the weight loss and browning index. A significant effect was obtained for CKL 50% films, of which the weight loss was reduced from 45.17% (control) to 9.22%. Meanwhile, the browning index was successfully reduced from 400 (control) to 120.

Several studies have shown that ascorbic acid was able to reduce weight loss and browning of fruit and vegetables. Ayranci and Tunc [21] has studied the effects of ascorbic acid addition in methylcellulose film. The methylcellulose-ascorbic acid film was reported able to control browning and reduce vitamin loss in mushrooms and cauliflower. In another study, Perez-Gago et al. [22] had successfully control browning in fresh-cut potatoes and apples by using whey protein concentrate-ascorbic acid film. It is known that natural additives are normally rich which compounds that can act as antioxidants and antimicrobial activity [13,23]. Therefore, it can be concluded that the presence of ascorbic acid in key lime extract may act as antioxidant that prolonged the freshness of cherry tomatoes.

TABLE 4. Weight loss and browning indices of cherry tomatoes wrapped using chitosan and CKL films.

Film	Weight loss (%)	Browning index
Control (no film)	45.17	400
Chitosan	26.67	330
CKL 25%	18.93	250
CKL 50%	9.22	120

IV. CONCLUSIONS

In this research, chitosan-key lime films have been successfully developed. The incorporation of key lime extract into chitosan, particularly at concentration of 50% (v/v), has a significant influence on transparency, thermal, mechanical and antimicrobial properties of chitosan film. The chitosan-key lime films have great UV barrier property. Chitosan-key lime films prolonged the freshness of cherry tomatoes. Overall, results from this study highlight the feasibility of key lime extract as an alternative to synthetic additives for food preservation. The key factor for this behaviour is the presence of ascorbic acid in key lime extract.

ACKNOWLEDGMENT

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C – 03

Indonesian Natural Zeolites as potential Adsorbent in Waste Cooking Oil Regeneration

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***Abstract*—** This study aimed to know the effect of zeolite modification toward density and water content of waste cooking oil after adsorption and to know the optimum temperature of waste cooking oil adsorption using natural zeolite. Natural zeolite was prepared by dipping in aquadest for 1 hour then dried in oven at 120°C for 2 hours. Zeolite was activated by dipping in HF solution (1%v/v) with volume ratio 1:2. Sample was filtrated and washed using aquadest followed by calcinations at 500°C. Adsorption process was done in batch system at various temperature (50, 60, 70, 80, 90 and 100°C). After adsorption, waste cooking oil was separated from zeolite then was characterized to determine the density, % free fatty acid(FFA), and water content. The results showed that: modification zeolite using HF caused FFA and water content of waste cooking oil decreased. The optimum temperature of waste cooking oil adsorption was 70°C with value of density, %FFA and water content respectively were 0.8593 g/mL , 0.056%, 0.200%

Keywords: *adsorption, waste cooking oil, zeolite*

I. INTRODUCTION

During frying, cooking oil made of palm oil is heated in the presence of air. This process causes degradation reaction in cooking oil. The degradation reaction is caused by heat, oxygen from the air, and water. Hydrolysis occurs in the presence of water. The reaction yield free fatty acids, monoglycerides, diglycerides and glicerols. Oxidation occurs in the presence of oxygen. Some carbonyl compounds are formed in this process [1]. The degradation reaction will make the quality of the oil drops and cause bad effect to humans. Several parameter is usually used as quality indicator of the oil. The parameter are free fatty acid, iodine value, peroxide value, viscosity, spesific gravity.

Waste cooking oil can flow to the water environtent and cause environmental problems so it is important to reduce amount of waste cooking oil [2,3]. The better method to reduce amount of waste cooking oil is make another product from waste cooking oil for example biodiesel. Some treatments is needed to increase quality of waste cooking oil before the waste cooking oil is changed to another product.

Adsorption is widely used to increase quality of waste cooking oil. This method is relatively easy and cheap so it brings economical benefit. Indonesian natural zeolite can be used as adsorbent. Natural zeolites is easily found in Wonosari Indonesia so the price is low. Unfortunely the natural zeolites contain some impurities. Some efforts is needed to increase the quality of natural zeolite. The activation process should be done before use natural zeolite as adsorbent. Activation using acids is commonly used in activation process. For nonpolar adsorbate such as waste cooking oil it is important to increase the Si/Al ratio of natural zeolite due to better interaction of adsorbate-adsorbent.

II. EXPERIMENTAL PROCEDURES

A. Preparation of Zeolite

Natural zeolite was obtained from Wonosari Indonesia. The zeolite samples were prepared in 100 mesh particle size then washed with aquadest and dried in oven at 120°C for 2 hours. Zeolite was calcined at 500°C for 4 hours then ZA was obtained. ZA was immersed in 1% v/v HF for 10 minutes; using zeolite : acid ratio = 1: 2 v/v. After that, the mixture was washed with aquadest to remove excess acids. The mixture was dried in oven at 120°C for 2 hours and calcined at 500°Cfor 4 hours then ZA-HF was obtained.

B. Characterization of zeolite

Determination of Si/Al ratio. The values of Si/Al ratio were determined by AAS.

Determination of Acidity. Acidity of zeolite was determined using gravimetric method using ammonia as adsorbate. Sample were placed in a crus and heated at 120^{o}C for 2 hours. The weight of the sample was measured and noted as W. Sample was placed in vacuum dessicator ad let ammonia flow into dessicator until the dessicator was full of ammonia. Sample was kept in that condition for 24 hours. The weight of the sample was measured (W1). Acidity was amout of ammonia which was adsorbed for a gram sample.

$$\Delta W = (W1 - W) \quad \text{(mgram)}$$

$$\text{acidity} = (\Delta W / M\ NH_3) \ \text{mmol}$$

where ΔW is weight of adsorbed ammonia, M NH_3 is Molecular weight of ammonia

C. Adsorption of Waste Cooking Oil

Waste cooking oil was obtained from fried food producer in Yogyakarta Indonesia. Fifty grams of waste cooking oil and 10 grams of various zeolite (ZA and ZA-HF) were mixed in beaker glass. The mixture was heated and stirred at various temperature (50,60,70,80,90,100^{o}C). Adsorption was carried out for 60 hours. After cooling at room temperature, the mixture was poured into funnel with filter paper (whatman 42) under vacuum.

D. Characterization of Waste Cooking Oil

*Density (ρ).*Density of water cooking oil was measured using picnometer.

$$B = B_2 - B_1$$

$$\rho = \frac{B}{V}$$

Where ρ is density (g/mL), B1 is mass of empty picnometer, B2 is mass of waste cooking oil + picnometer,V is volume of waste cooking oil [4]

Water Content. Water content determined by hot plate method. Five grams until 20 grams waste cooking oil in beaker glass was stirred and then heated using hot plate. The beaker glass was rotate slowly. Temperature of waste cooking oil less than 130^{o}C. Waste cooking oil was cooled at room temperature after there was no gas came out from the oil. Weight of waste cooking oil was measured [5].

$$\text{Water content(\%)} = \frac{\text{lost mass (g) x 100}}{\text{Mass of initial sample (g)}}$$

*Free Fatty Acid (FFA).*About 28.2 of well mixed oil added with 50 mL alcohol and phenolphtalein. The mixture is then titrated with 0.1 N NaOH with vogorous shaking until a permanent faint pink appeared and persisted at least for 1 minute

$$\%\ \text{FFA} = \frac{\text{V. NaOH x N.NaOHx M}}{\text{M x 1000}} \text{ x 100\%}$$

Where m is the mass of the test portion, N the normally of NaOH , V the volume of NaOH consumed, in mililiters, M the molecular weight of free fatty acid [5]

III. RESULT AND DISCUSSION

A. Si/Al ratio of zeolite

Table 1 showed that Si/Al ratio of ZA-HF was higher than Si/Al ratio of ZA. It means that modification using HF affect Si/Al ratio. After immersed in HF solution, the Si/Al ratio of natural zeolite was higher. HF reacted with zeolite caused the framework Al was extracted from zeolite. This treatment lead to the increase of Si/Al ratio.

Table 1. Si/Al ratio and acidity of zeolite

Nama Sampel	Rasio mol Si/Al	Keasaman (mmol/g sampel)
ZA	4,950	699,941
ZA-HF	5,132	755,529

Modification of zeolite to get higher Si/Al ratio was important for hidrophobic adorbate. If the Si/Al ratio was high, the charge density of the zeolite framework was low, do to insufficient number of cations within the pore system[7]. This condition caused hidrophobic molecul has stronger interaction with zeolite. Fig. 1 showed the reaction of zeolite with HF solution.

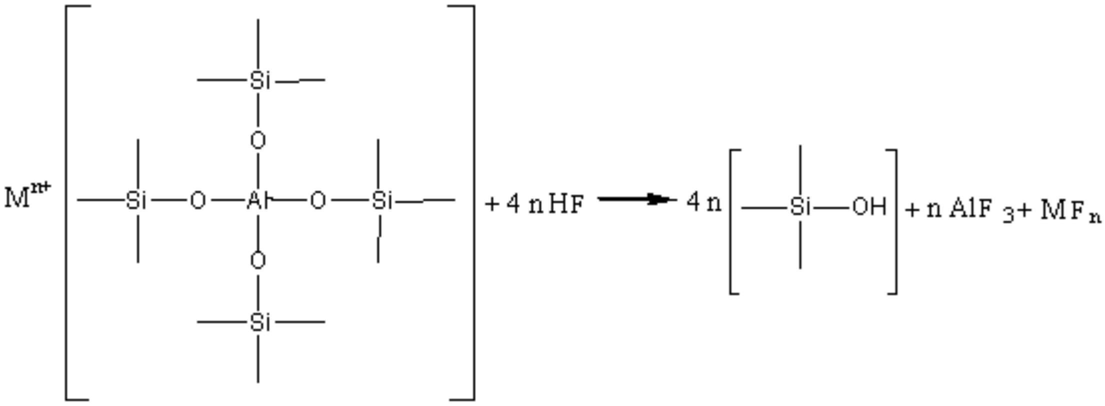

Figure 1. Dealumination zeolite using HF

B. Acidity of Zeolite

The term acidity here was total acidity consist of Lewis acid and Bronsted acid. Table 1 showed that dealumination using HF caused acidity of zeolite increase from 699,411 to 755,529 mmol/g. A decrease in the Al content (rise in Si/Al) decreased the charge density of the anion framework of zeolite. Thus, the hydroxyl groups were subjected to less intense interaction with the framework, which should decrease the force constantof the OH oscilator and fascilitate the deprotonation i.e enhance the acidity strength[7]. Lewis acid sites in zeolite might occur as three fold-coordiated aluminum or silicon and/or extraframework aluminum. Lewis sites formed upon dealumination of zeolite [7]. The increase in acidity of zeolite was important because the acid site of zeolite act as active site which did interaction with adsorbate.

C. Density

Waste cooking oil which was used in this research had dark colour. The colour became clearer after adsorption using zeolite (ZA and ZA-HF). By varying the temperature, density of waste cooking oil was observed (Figure 2 and Table 2). Density of waste cooking oil after adsorption was lower than waste cooking oil before adsorption. Waste cooking oil contain many materials from frying food. After adsorption, the impurities material was adsorbed on zeolite so the density of waste cooking oil was lower than before adsorption. The highest density of waste coking oil was 0,8944 g/mL. It was reached at 80^{o}C. The lowest density of waste cooking oil was reached at 50^{o}C with density 0,8419 g/mL.

Tabel 2. Density, % FFA, and Water Content values of waste cooking oil

Sampel	Temperature(%C)	Density (g/mL)	FFA (%)	Water content (%)
Waste cooking oil	70	1,0132		11,297
Fresh cooking oil	70	0,9700		0
Oil after adsorption	50	0,8716	0,078	4,824
Oil after adsorption	60	0,8593	0,057	0,524
Oil after adsorption	70	0,8944	0,056	0,2
Oil after adsorption	80	0,8607	0,085	0,36
Oil after adsorption	90	0,8624	0,058	0,159
Oil after adsorption	100	0,8419	0,076	1,213

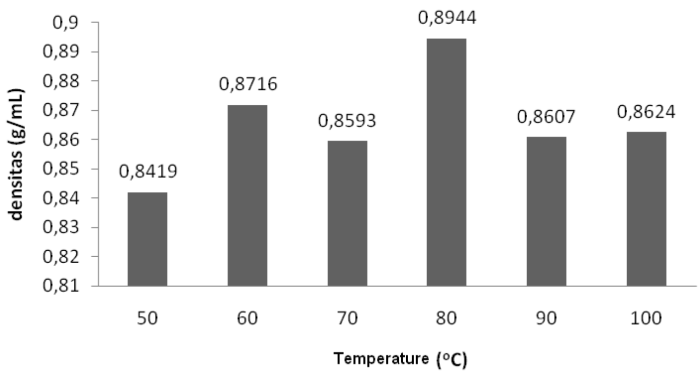

Figure 2, Density of waste cooking oil at various temperature

D. Free Fatty Acid (FFA)

FFA in cooking oil or on the surface of fried food used to predict the life of the food with respect to the development of rancidity. FFA were formed from hydrolysis oil. Water caused hydrolysis oil procedure fatty acid and glicerol. The hydrolysis occured rapidly in the presence of acid, base, enzim, and high temperature[2].

Zeolite activation using HF affected the ability of zeolite to decrease % FFA in waste cooking oil. Value of FFA which was adsorbed on zeolite without activation (ZA) was lower than FFA which was adsorbed on activated zeolite (ZA-HF). Effect of ativation using HF toward %FFA was shown in Fig 3. This result due to better interaction of waste cooking oil and zeolite. Activation using HF lead to higher acidity so zeolite had more active site to interact with waste cooking oil. The activated zeolite also had higher Si/Al ratio so the surface of zeolite was more hidrophobic and suitable for hidrophobic molecule such as waste cooking oil and its impurities.

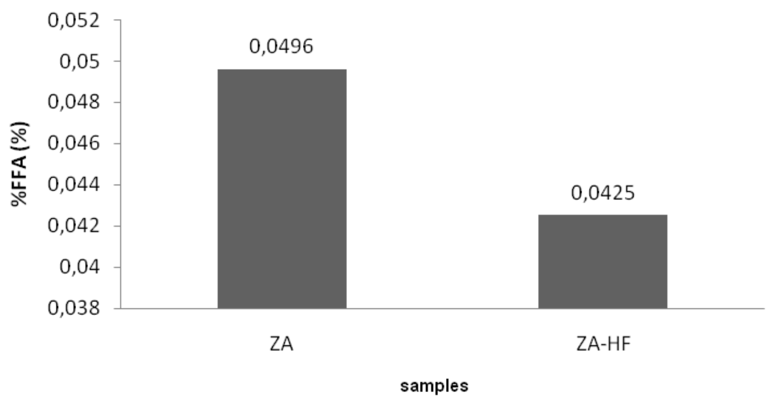

Figure 3. Effect of Activation using HF toward %FFA

Figure 4 showed that FFA value in adsorption at temperature 50-100^{o}C has occupied SNI 01-3741-2002 (below 0.3 %). The lowest FFA value was reached at 70^{o}C with FFA value 0.056 %. Figure 4 showed that FFA value in adsorption at temperature 50-100^{o}C has occupied SNI 01-3741-2002 (below 0.3 %). The lowest FFA value was reached at 70^{o}C with FFA value 0.056 %. At temperature 50-60^{o}C, FFA value decreased if temperature increased but after 80^{o}C, FFA value increased. For physisorpsi, the increase in temperature caused a decrease in adsorption capacity [8].

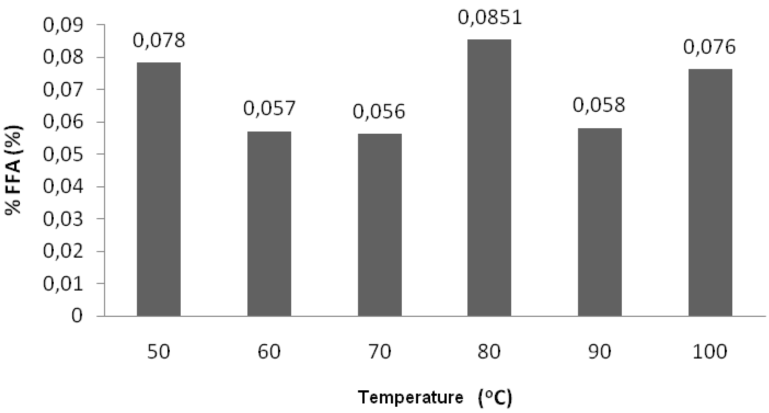

Figure 4. FFA value at various temperature

E. Water content

Result of this research showed that water content for fresh cooking oil; waste cooking oil before adsorption; waste cooking oil after adsorption using ZA; waste cooking oil after adsorption using ZA-HF respectively were 0%; 11.297%; 6.996%; 3.980% (Table 2). Water in waste cooking oil was adsorbed on zeolite so after the adsorptio process the water content decreased. The adsorption ability of zeolite treated with HF was higher than natural zeolite without HF treatment. HF cleaned zeolite pores so the pores were opened and the active sites easily interact with water in waste cooking oil as adsorbate. Without activation using HF some impurities did interaction with active sites caused adsorbate was not able to do interaction with active sites.

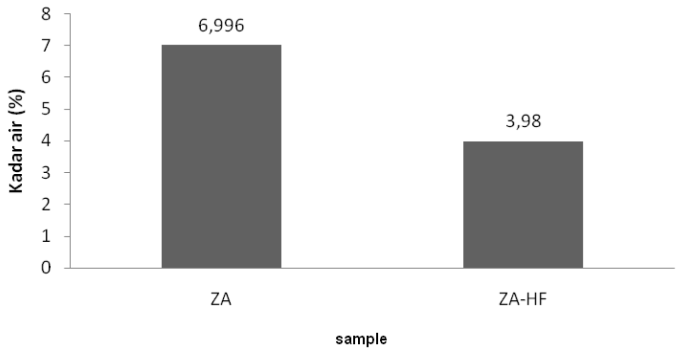

Figure 5. Effect of Activation using HF toward water content

At temperature 50-90^{o}C, water content decreased with increase in temperature. It means adsorption was better at higher temperature. Increase in temperature means an increase in mobility of the adsorbate molecule and an increase in the number of active sites for the adsorption [9]. With chemisorpsi, higher temperature could improve performance[8]. The enhancement of adsorption capacity of adsobate at higher temperature due to enlargement of pore size and activation of zeolite adsorbent[10].

As shown at Fig.6 , at temperature 100^{o}C, water content was higher than the water content at 60-90^{o}C. During physisorpsi, increase in temperature caused desorption rate increase. Species that were physically adsorbed to solid could be released by applying heat[8]. Increasing temperature decreased the adsorption capacity because adsorptive forces between adsorbate and the active sites on the adsorbent surface decreased [11].

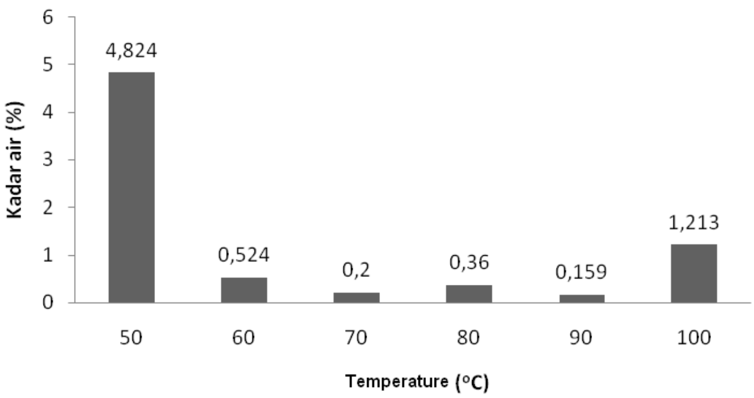

Figure 6. Water Content at Various Temperature

IV. CONCLUSION

Modification zeolite using HF caused FFA and water content of waste cooking oil decreased. The optimum temperature of waste cooking oil adsorption was 70°C with value of density, %FFA and water content respectively were 0.8593 g/mL , 0.056%, 0.200%

ACKNOWLEDGMENT

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C – 04

QSAR STUDY OF ANTIMALARIA OF XANTHONE DERIVATIVES USING MULTIPLE LINEAR REGRESSION METHODS

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Abstract— Research on Quantitative Structure Activity Relationship (QSAR) analysis of xanthone derivatives had been conducted to obtain new antimalaria active compounds. The QSAR analysis was carried out using the semi empirical method of AM1 with the descriptors of atomic net charge, log P, dipole moment, polarizability, mass and volume. Statistical analysis was performed using the multilinear regression analysis. Then, the xanthone was designed using the validated best QSAR equation. The QSAR equation describing the relationship between antimalarial activity and parameter of lipophilicity, electronic and steric properties of xanthone was:

$\text{Log } (1/IC_{50}) = (2.726)qC_1 + (1.783)qC_{10} + (0.2387)\log P + 5.282$

$(n = 17,\ r^2 = 0.683,\ F_{calc}/F_{table} = 4.309,\ PRESS = 0.652)$.

Keywords: *QSAR, xanthone, antimalaria, multiple linear regression*

I. INTRODUCTION

Malaria continues to be main health problem and deadly parasitic disease in the world. During 100 years, the world has not given clear contribution to the curing of the disease. In addition, World Health Organization (WHO) [1] reported that 41% of world population (2.3 billion people) was threatened, 300-500 million were infected, 1.5-2.7 million were died by malaria. In recent years, progress has been made in malaria control as a result of insecticide-treated bed nets and effective treatment. But the development of resistance to insecticides and medicines as well as the poor quality of the health systems in many affected countries pose threats to these achievements [1]. Malaria could be treated by oral medication. However, it constantly changes, especially through the development of parasite (such as *P.falciparum*), which is resistance to standard anti malaria drugs, such as chloroquin. Therefore, the discovery and development of new effective anti malaria drugs are urgently required to solve the problems.

In this connection, Quantitative StructureActivity Relationship (QSAR) analysis plays an important role to minimize trial and error in designing new antimalarial drugs. In a QSAR analysis, the central task is to find a regression function that predicts the activity of the molecule in high accuracy. Hence, the present study is aimed at to establish the QSAR between experimental antiplasmodial activity and structure electronic descriptors which may focus on the molecular structures of the compounds. In last decades, QSAR have been applied in many areas enabling to prevent time consuming and cost during the analysis of biological activities of interest [2].

Experimental data used in the computational chemistry study were anti plasmodium activity of xanthone derivatives (IC_{50}) which were obtained from [3]. The lipophilicity, electronic and steric parameters of xanthone derivatives could be determined and then used as descriptor in Quantitative Structure Activity Relationship (QSAR). The QSAR study was conducted based on linear relationship between log IC_{50} and atomic net charge of atoms on xanthone skeleton. Data of atomic net charge obtained from computational calculation using semi empirical method of AM1 was analyzed using linear regression analysis using statistic software.

According to the results of QSAR analysis, the most active site of molecule, i.e. the one which is responsible to the antimalarial activity, could be predicted. Then, the design of xanthone molecule could be done by modifying the position of substituents. The position of substituents would be better to conduct on the active site. The molecule with low IC_{50} has high activity and could be proposed to synthesize in laboratory. Therefore, the design of xanthone derivative with higher activity could reduce the trial and error experiments in the laboratory as well as the cost and time.

II. EXPERIMENTAL SECTION

A. Materials

Xanthone derivatives compounds were taken from [3]. The structure of xanthone compound is illustrated in Figure 1, while the structures of xanthone derivatives as well as their antimalarial activities are presented in Table 1.

B. Instrumentation

For this study, a Laptop equipped with AMD E-450 APU with Radeon® Processor 1.65 GHz and RAM 2.00 GB. All the compounds (Table 1) were calculated using package HyperChem® Program Version 8.0 for Windows (license: Iqmal Tahir Universiti Malaysia Perlis) and complete geometry optimization with the semi-empirical AM1 method, statistical program IBM® SPSS® version 22 for Windows.

C. Procedure

QSAR descriptors were calculated for each of the compounds using the QSAR module of semi-empirical AM1 method. The QSAR models are evaluated using sets of xanthone derivatives compounds whose molecular structure and antiplasmodial activity are known. Antiplasmodial activity of these compound were taken as the activity against chloroquine resistant *P. falciparum* (FcB1/Colombia strain) and is presented as the value of log $1/IC_{50}$ where IC_{50} is an effective concentration inhibiting 50% growth of the parasite. All the compounds were calculated using HyperChem® and complete geometry optimization with the semi-empirical AM1 method was performed. The geometry was optimized to an RMS gradient of 0.001 kcal/(Å mol) in vacuo (Polak-Ribière method). Quantum chemical descriptors were calculated, as for example: atomic net charges, dipole moment, log P, polarizability, volume and molar mass. From all the descriptors above mentioned, it can be considered that some of them give valuable information about the influence of electronic, steric and coefficient partition features upon the biological activity of drug molecules. In this work, the molecular descriptors were selected so that they represent the features necessary to quantify the activity.

The QSAR model was generated by Multiple Linear Regression (MLR) Backward method by using SPSS package. It relates the dependent variable $\hat{y}$ (biological activity) to a number of independent variables x_i (molecular and electronic descriptors) by using linear equations. This method of regression estimates the values of the regression coefficients by applying least square curve fitting method. The model was chosen based on some statistical parameters such as r^2, F_{calc}/F_{table}, and PRESS. The developed QSAR models were validated using the following statistical measures: r^2 (coefficient of determination) and q^2 (cross-validated r^2 by LMO).

III. RESULTS AND DISCUSSION

Analysis of quantitative relationship between structure and activity conducted in this research included : determination of xanthone derivatives with high antimalarial activity which were obtained from the previous research [3]; optimization of xanthone structure; determination of descriptors; calculation of descriptor through the structure optimization; statistical analysis to give QSAR equations; determination of the best QSAR equation and design of xanthone derivative based on the best QSAR equation.

In this research AM1 semi-empirical methods were used to calculate a number of descriptors, because the samples in this research i.e. xanthone derivatives have large number molecular compounds and bulky structures. The AM1 semi empirical method is easier to calculate a number of descriptors than using PM3 semi-empirical method. In current practice, AM1 semi-empirical methods serve as efficient computational tools which can yield fast quantitative estimates for a number of descriptors. This may be particularly useful for correlating large sets of experimental and theoretical data, for establishing trends in classes of related molecules, and for scanning a computational problem before proceeding with higher level treatments [5]. The structure of xanthone was presented in Figure 1. Xanthone derivatives consisted of functional groups attached on carbon atom and their antimalarial activities reported by [3] were presented in Table 1.

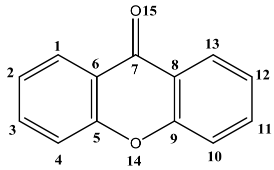
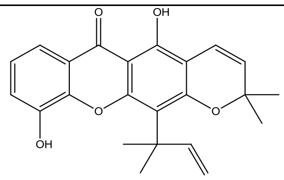
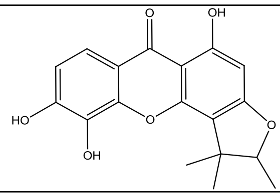
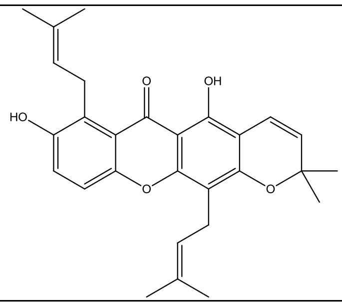
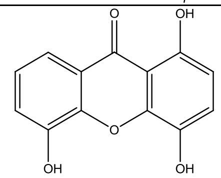
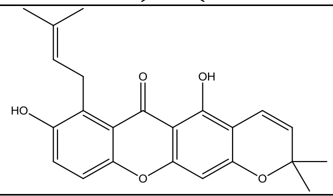
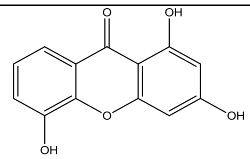
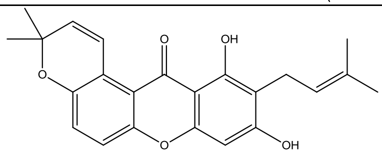
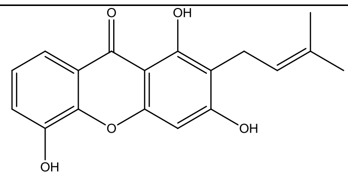
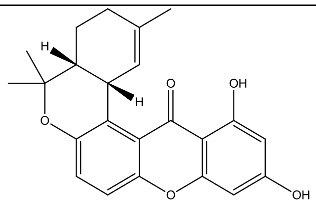
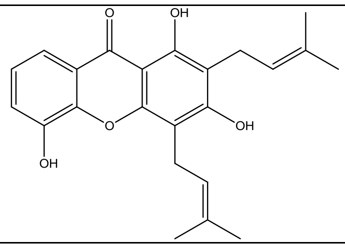
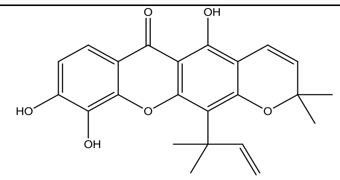
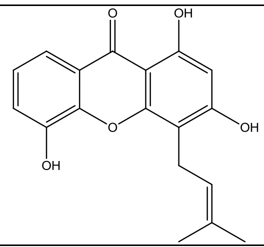
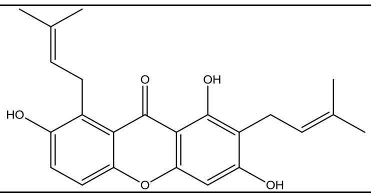
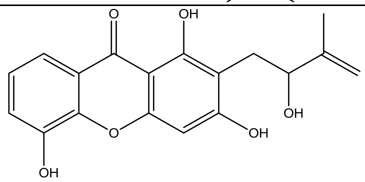
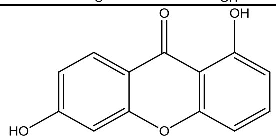
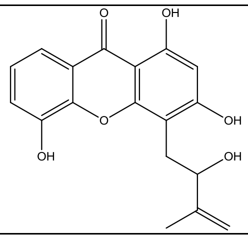
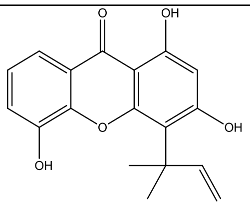
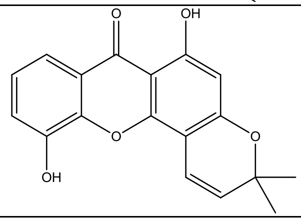
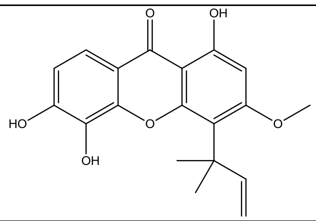
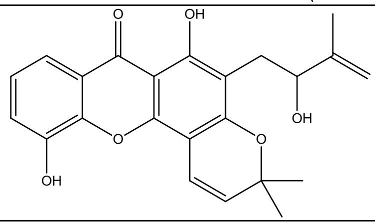
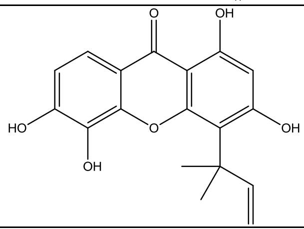


Figure 1 Structure of xanthone

Table 1. Xanthone derivatives and their antimalarial activities by [3]

Comp	**Structure**	**IC_{50} (μg/mL)**		**Comp**	**Structure**	**IC_{50} (μg/mL)**
1[a]		1.3 ± 0.5		12[a]		3.5 ± 0.3
2[b]		0.9 ± 0.2		13[a]		3.5 ± 0.3
3[a]		1.0 ± 0.1		14[a]		24.7 ± 2.1
4[a]		2.7 ± 0.8		15[a]		4.9 ± 1.5
5[a]		4.4 ± 0.2		16[b]		1.8 ± 0.7

6[a]		1.9 ± 0.3		17[a]		4.1 ± 0.5
7[a]		0.8 ± 0.1		18[a]		3.7 ± 0.4
8[b]		4.2 ± 2.0		19[a]		6.6 ± 0.8
9[a]		1.6 ± 0.4		20[a]		1.4 ± 0.4
10[b]		3.2 ± 0.6		21[a]		5.4 ± 1.8
11[a]		2.3 ± 0.6				

[a]Training set
[b]Test set

Descriptor is parameter of molecular properties employed as variable in the QSAR research. The lipophilicity, electronic and steric parameters of xanthone derivatives could be determined and then used as descriptor in Quantitative Structure Activity Relationship (QSAR). Descriptors used in this research were atomic net charge, dipole moment (μ), logarithmic partition coefficient (log P), polarizability (α), mass (M) and volume molar (V). The optimization process was conducted to obtain the properties of structures and followed with the data recording via single point menu. Method used to calculate the electronic properties and descriptors was AM1.

Results of QSAR analysis

A good fit was assessed based on the determination squared correlation coefficients (R^2), standard deviation (*SD*) and Fisher's statistic (*F*). Most of the QSAR modeling methods implement the leave-one-out (LOO) or leave-many out (LMO) cross-validation procedure, which are internal validation techniques [6]. LOO cross-validation procedure consists of removing one data point from the training set and constructing the model only on the basis of the remaining training data and then testing on the removed point. LMO cross-validation procedure calculates the models leaving multiple observations out at a time, reducing the number of times it has to recalculate a model. The outcome from the cross-validation procedure is cross-validated R^2 (LOO-q^2 or LMO-q^2), which is used as a criterion of both robustness and predictive ability of the model. In this research, the leave-4-out cross-validation method as the internal validation tool was performed.

The total set of compounds was manually divided into a training set (17 compounds) for generating 2D QSAR models and a test set (4 compounds) for validating the quality of the models. Selection of the training set and test set molecules was done on the basis of structural diversity and a wide range of activity such that the test-set molecules represent a range of biological activity similar to that of the training set; thus, the test set is truly representative of the training set [7]. This approach resulted in selection of compounds 2, 8, 10 and 16 as the test set and the remaining 17 compounds as the training set. The uni column statistics of the training and test sets is reported in Table 2.

The maximum and minimum value in training and test set were compared in a way considering that: (i) the maximum value of log1/IC_{50} of test set should be less than or equal to maximum value of log1/IC_{50} of training set and (ii) the minimum value of log1/IC_{50} of test set should be higher than or equal to minimum value of log1/IC_{50} of training set. Table 2 shows that average and standard deviation values of training and test set are not different significantly, indicating a similar data distribution in both.

Table 2. Uni-column statistics of the training and test sets for QSAR models

Set	Number of Data	Average	Max	Min	St. Dev	Sum
Training	17	5.530	6.097	4.607	0.359	94.013
Test	4	5.666	6.046	5.377	0.296	22.662

Multiple linear regression method is the standard method for multivariate data analysis. It estimates the values of the regression coefficients by applying least squares curve fitting method. For getting reliable results, dataset having typically 5 times as many data points (molecules) as independent variables (descriptors) is required.

In first step of model development, all of the descriptors (atomic net charge, dipole moment (μ), logarithmic partition coefficient (log P), polarizability (α), molecular mass (M) and molar volume (V)) were included. These parameters were used to represent properties such as lipophilicity, shape and electron distribution, which were believed to have a major influence on the drug’s activity [8]. Based on statistical backward analysis, the non-significant descriptors were excluded from the model. QSAR investigations of the xanthone series resulted in several QSAR equations, considering the term selection criterion as R^2, F and PRESS. Some statistically significant 2D QSAR models were chosen for discussion (Table 3 and 4).

Table 3. Statistical parameters of 5 QSAR models of xanthone derivatives

Model	Descriptor	R	R^2	F_{calc}	F_{table}	F_{calc}/F_{table}	PRESS
1	qC10, qC1, log P, qC3, qC9	0.853	0.727	5.855	2.167	2.702	0.562
2	qC10, qC1, log P, qC9	0.837	0.701	7.029	2.167	3.244	0.615
3	qC10, qC1, log P	0.826	0.683	9.336	2.167	4.309	0.652
4	qC10, log P	0.806	0.649	12.957	2.167	5.980	0.721

Table 4. Coefficient of selected independent variables for QSAR models as obtained from multilinear regression analysis

Model	Atomic net charges (coulomb)				Log P	Constant
	qC_1	qC_3	qC_9	qC_{10}		

1	4.5514	-0.7321	4.3214	3.1194	0.1680	5.0792
2	3.4938		2.6007	2.4519	0.2022	5.1260
3	2.726			1.783	.2387	5.282
4				1.773	.307	4.897

According to the statistical calculation, it was obtained the strong correlation between the electronic and lipophilic parameters to the antimalarial activity of the substituted xanthone. All of the QSAR models have shown good correlation between their corresponding descriptors and biological activity. The higher the F value is, the more significant the data would be. Data would be significant if $F_{calc}/F_{table} > 1$. According to the F_{calc}/F_{table} value, it indicated that the models fits in all cases was not a chance occurrence and all models were statistically significant. Based on the R^2 criteria ($R^2 > 0.6$), all of the model were passed to validation step. To validate the selected prediction function, a cross-validation and an external test were carried out. Cross-validation is a practical and reliable method for testing the significance.

The developed QSAR models were validated using the following statistical measures: r^2 (coefficient of determination) and q^2 (cross-validated r^2 by LMO). A QSAR model is considered to be predictive, if the following conditions are satisfied: $r^2 > 0.6$ and $q^2 > 0.6$. The r^2 and q^2 values were used as deciding factors in selecting the optimal models [9].

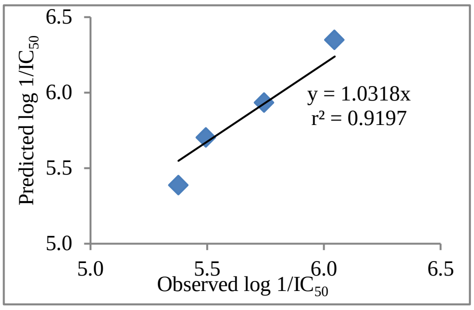
The predicted (LMO) activities of the xanthone derivatives by the above models are shown in Table 5. The result of evaluation antimalarial activity [predicted log IC_{50}] and correlation with antimalarial activity [experiment log IC_{50}] for the model 3 by using semi-empiric AM1 method of test set and training set can be seen at Figure 2 and Figure 3. The statistically best significant model obtained by MLR method (Model 3) with $r^2 = 0.919$ was considered, as the model showed good internal predictive power ($q^2 = 0.68$) of 68% and predictivity for the external test set (pred_$r^2 = 0.50$) of about 50%. Consequently, QSAR model 3 can be considered as the most suitable model for antimalarial activity against FcB1/Colombia strain of *P.falciparum* with both high statistical significant and excellent predictive ability. The best QSAR equation was as follows:

$$\text{Log } (1/IC_{50}) = (2.726)qC_1 + (1.783)qC_{10} + (0.2387)\log P + 5.282$$

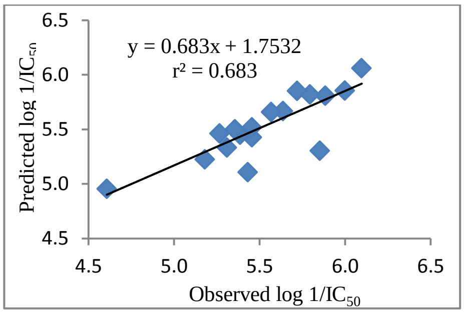
$$(n = 17,\ r^2 = 0.683,\ F_{calc}/F_{table} = 4.309,\ PRESS = 0.652).$$

Table 5. Comparison of observed and predicted values of log $1/IC_{50}$

Compound	log1/IC50 observed	Predicted log1/IC50			
		Model 1	Model 2	Model 3	Model 4
2	6.046	6.414	6.341	6.348	6.331
16	5.745	5.887	5.902	5.933	6.102
10	5.495	5.692	5.769	5.702	5.647
8	5.377	5.252	5.377	5.385	5.173
PRESS		0.210	0.187	0.170	0.273
r^2		0.831	0.894	0.919	0.775
q^2		0.73	0.70	0.68	0.65
pred_r^2		0.38	0.44	0.50	0.19



(a)



(b)

Figure 2. Plot of observed versus predicted log 1/IC_{50} values of xanthone derivatives of (a) Test set and (b) Training set by Model 3

Based on the coefficient of descriptor parameters involved in the QSAR model 3 in which seen on the atomic net charge descriptor, thus the active region of xanthone compounds can be predicted. The atoms which have an influence on antimalarial activity were C_1 and C_{10}. The active region can be illustrated in Figure 3. The bold line in this figure shows the active central area allegedly providing antimalarial effect. This can happen, because they contribute quite active to the influence of the quantity of biological activity. The changes in the values of the atomic charges in active areas would result in changes in the value of antimalarial activity.

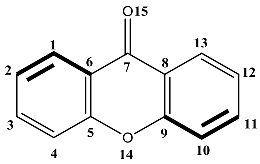
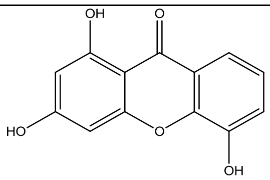
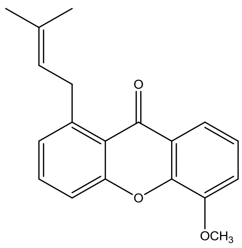


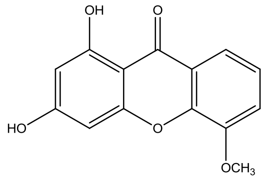
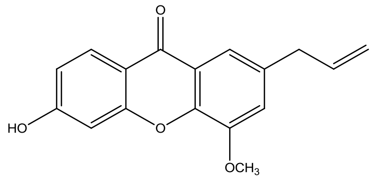
Figure 3. The hypothetical active region of xanthone structure

Design of new xanthone derivatives

The best QSAR equation was model 3, in which there were variables of qC1, qC10 and log P that strongly affect the antimalarial activity. Therefore, to design xanthone derivatives with high antimalarial activity, all of those variables should be considered. Substitution was conducted by varying the functional groups on the active site and also considering the ease of synthesis process as well as the availability of chemical in the laboratory. The new xanthone derivatives and the calculation of its log 1/IC_{50} were presented on Table 6.

Table 6. The new xanthone derivatives and their IC_{50} prediction

No	Compound	qC1	qC10	logP	log1/IC_{50}	IC_{50} (µg/mL)
1		0.2196	0.0615	1.80	6.42	0.38
2		0.0351	0.0224	3.95	6.36	0.44

3		0.2184	0.0252	1.83	6.36	0.44
4		-0.0131	0.0573	3.16	6.10	0.79

IV. CONCLUSION

The QSAR equation describing the relationship between antimalarial activity and parameter of lipophilicity, electronic and steric properties of xanthone was: Log $(1/IC_{50}) = (2.726)qC_1 + (1.783)qC_{10} + (0.2387)\log P + 5.282$ ($n = 17$, $r^2 = 0.683$, $F_{calc}/F_{table} = 4.309$, PRESS = 0.652).

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C – 05

COMPOUND ANALYSIS OF KEMBANG BULAN (Tithoniadiversifolia) LEAVES

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***Abstract*—** This study aimed at analyzing the compounds in chloroform fraction of Tithonia diversifolia leaves using maceration method and further analyzing the compounds based on the UV-Vis spectroscopy, IR and GC-MS analyses.
Extract of Tithonia diversifolial eaves were macerated with methanol. Methanol extract obtained from the maceration was then evaporated and partitioned with n-hexane and chloroform. Chloroform fraction was further evaporated and separated using GCC guided by TLC. The compounds obtained from GCC were identified by using TLC with 3 different types of eluent mixture.
The showed that the isolation of compound which was analyzed using UV-Vis spectroscopy gave the maximum wavelength (λ_maks) at 220.80 nm and 400.20 nm. IR spectrum showed functional groups C=O carbonyl, –OH carboxylate, C-O ester, and C-H aliphatic. The result of GC-MS analysis showed that secondary metabolite compound which was isolated has a similarity index (SI) to17β-(acetyloxy)-2α-methyl-5α-estran-3-one of 75 with a purity of 69.53%.

Keywords: compound, analysis, Tithonia diversifolia leaves

I. INTRODUCTION

As a tropical country, Indonesia hasa large amount of plant species thriving in its region. Not only plants used for food and for industrial export, but also plants that can be used in the field of medicine for natural treatment. Thus, today many alternative treatments using various types of herbs are found in Indonesia.

Medical treatment with natural ingredients has existed for hundreds of years and cannot be removed from the daily life of Indonesian people. One of the competitive advantages of this treatment is that the side effects are relatively small compared to the chemical treatment. In addition, traditional medicines are easy to obtain and can be processed easily by almost everyone. This suggests that the treatment through natural ingredients can still compete at present time despite the rapid advances in science and technology. Furthermore, with the great advancement of technology many scientists start optimizing the utilization of various medicinal plants for more efficient treatments. One of the natural plants which is often prescribed in traditional medicine is *Kembang Bulan* (*Tithoniadiversifolia*). This plant usually grows wild in steep places, such as on cliffs, river banks, and ditches. In addition, this annual plant can grow well in places with high light-intensity at the height of 5-1500 meters above sea level.*Kembang Bulan* has a straight-erected stems, three-branched leaves with greenmain veins and others branching off, yellow flowers, and the roots are in the form of a taproot (Hutapea, et.al., 1994).

Based on various studies it is known that the leaves *Kembang Bulan* (*Tithoniadiversifolia*) can be used to treat stomach-ache, bloating, bloody injury, and as anti-inflammatory and antidiabetic. Further research reveals that the leaves of this plant contain alkaloids, terpenoids, flavonoids, saponisn, tannins, and polyphenols. These compounds are included in the class of secondary metabolites, thus allowing these plants to be used for medical treatment.

This study was carried out to isolate and identify secondary metabolites from *ethyl acetate* fraction of *Kembang Bulan* leaves. The extraction method used in this study was maceration. This method was chosen because it has several advantages, i.e. there quired toolsare relatively simple; it can be used for extraction in large quantities, the cost is relatively low, and it can be performed at room temperature without heating. This process technically used methanol solvent and the result was then partitioned using n-hexane. Methanol was used as a solvent because it can dissolve almost all kinds of secondary metabolites. The process of compound separation was conducted using Gravity Column Chromatography (GCC) method. To determine the purity of the compound and the GCC eluent a Thin Layer Chromatography (TLC) test was conducted. To determine the characteristics of the structure, a further analysis of pure compounds resulted from the isolation was conducted using UV-Vis spectrophotometer, infrared (IR) spectroscopy and Nuclear Magnetic Resonance (NMR) spectroscopy. The result of this study is expected to optimize the use of the *Kembang Bulan* as traditional and modern medicine.

The study aims to:

1. analyze the compound of *Kembang Bulan* (*Tithoniadiversifolia*) leaves using Thin-layer Chromatography (TLC) and Gravity Column Chromatography (GCC), UV-Vis (Ultraviolet-Visible) spectrophotometer, IR (infrared) spectroscopy, and GC-MS Spectroscopy; and
2. reveal the type of compound in the of ethyl-acetate fraction of *Kembang Bulan* (*Tithoniadiversifolia*) leaves by maceration method and separation by chromatography.

The benefits that can be drawn are, among others:

1. to provide information on how to analyze the chloroform fraction of *KembangBulan* (*Tithoniadiversifolia*) leaves;
2. to provide information concerning the chemical compound in ethyl acetate fraction of KembangBulan (*Tithoniadiversifolia*) leaves.
3. to contribute in developing science in chemistry, especially organic chemistry and pharmaceuticals.

II. REVIEW

Kembang Bulan flower can be classified as follows (Hutapea, 1997:297):

Division:Spermatophyta

Sub Division :Angiospermae

Class :Dicotyledoneae

Ordo :Asterales

Family :Asteraceae

Genus :Tithonia

Species: *Tithoniadiversifolia*

Kembang Bulan (*Tithoniadiversifolia*) is an upright shrub that can reach a height of 3 meters, have sprouts, and crept on the ground. Generally, this plant grows wild on steep places, for example on the cliffs, river banks, and ditches. This plant grows easily in places with a height of 5-1500 meters above sea level, and is also an annual plant that likes bright places and grows well in a place exposed to direct sunlight (Sulistijawati and Didik, 2001).

According Taofik, et.al. (2010), the extract of *Kembang Bulan* leaves contains an active ingredient that can kill the *eriophyidae* (mites that usually infest fowl). Based on his study, it is known that the extract of *Kembang Bulan* leaves has a toxicity level for *eriophyidae* mites at 2.2922 ppm during a 72-hour treatment. Using the phytochemical and High Performance Liquid Chromatography (HPLC) analysis, the study has shown that the extract contains flavonoids, alkaloids, and tannins. From this result it is known that *Kembang Bulan* plants have a potential to be utilized as botanical insecticide which is very economical.

Kembang Bulan is generally utilized traditionally for its leaves. The leaves contain active substances that can be used in medical treatment. Apart from being a botanical insecticide, a lot of research has also proven that the content of the active compounds in the leaves *Kembang Bulan* (*Tithoniadiversifolia*) can be used as medicine to treat antidiabetic, anti-virus, anti-malaria, liver, and strep throat. The plant of *Kembang Bulan* is shown in Figure 1.

Figure 1. *KembangBulan* (*Tithoniadiversifolia*)
(Source: personal documents).

III. RESULTS AND DISCUSSION

Separating *KembangBulan* (*Tithoniadiversifolia*) Leaves by Maceration and Partition

The result of the separation and partition leaf maceration *Kembang Bulan* (*Tithoniadiversifolia*) are shown in Table 1.

Table 1. Results of Separation by Maceration and Partitions

Material	Separation method	Solvent	ExtractVolume concentrated
0.5 kg dried powder of *Kembang Bulan* leaf	Maceration	Methanol	115 mL
	Partition	ethyl acetate	50.6 mL

1. **Separation of Ethyl acetate with Chromatography**

Separation technique performed by usingVacuum Liquid Chromatography is the first process to obtain secondary metabolites. In this technique a column of 9.5cm diameter and 5cm was used with tools such as a vacuum pump. Previously, the concentrated *ethyl acetate* extract using silica gel. Merck 60 (mesh). Eluent used in this process was 100% n-hexane, n-hexane: *ethyl acetate* in the ratio of n-hexane : ethyl acetate =6 : 4 Rf 0.4 ; acetone : ethyl acetate= 4 : 1 Rf 0.875; and dichloromethane : acetone= 9 : 1 Rf 0.425.

The subsequent separation process was conducted the gravity column chromatography. Fraction I results which have been concentrated and then impregnated with silica gel Merck 60 (200-400 mesh). The column used for chromatography is 30 cm in length with a diameter of 2.5 cm. Eluent used in this process a mixture of n-hexane : *ethyl acetate* in a ratio of 6:4.

The generated eluent was then collected in a 20 mL bottle fraction. This process resulted in 60 bottles of fractions, and each fraction was then identified using Thin Layer Chromatography (TLC) with an interval of 3 bottles. Fractions were grouped by determining the similar value of Rf; thus 6 groups of fractions, i.e. F1 (3-7), F2 (8-12), F3 (13-17), F4 (18-20), F5 (21-40), and F6 (41-60) were obtained. Of the six groups of the fraction, fraction F6 (41-60) was concentrated.

Fraction F6 (bottles 41-60) was concentrated further separation by TLC because the results have not shown single spot. The fraction of silica gel was impregnated using Merck 60 (mesh). The separation was carried out using n-hexane eluent: *ethyl acetate* in the ratio of 6: 4. The generated eluent was accommodated within ± 5 mL bottle fractions and fractions obtained 32 bottles. Each fraction was further identified using Thin Layer Chromatography (TLC) with the interval of one bottle.

-Based on the similarity value of Rf, all fractions were grouped into two groups, namely F(6A) fraction (no. 1-12) and F(6B) (no. 13-32). At TLC chromatogram, F6-A (1-12) showed a single spot so that the group of this fraction was further concentrated for the purity test.

The process of gravity column chromatography was carried out to obtain the components of secondary metabolite compounds in chloroform fraction of *Kembang Bulan* (*Tithoniadiversifolia*) leaf which is simpler. The column used here was with a diameter of 2 cm. A total of 1.00 g concentrated extract chloroform of *kembang bulan* (*Tithoniadiversifolia*) leaf that had been diluted with a little mixture of eluent n-hexane: ethyl acetate (6:4) and the stationary phase in the form of a mixture of silica gel Merck 60 (200-400 Mesh), resulting in 60 bottles of fractions.

The separation pattern of the whole fraction bottles was observed using TLC under UV light using the same eluent mixture. Bottles with the same separation pattern and Rf value can be combined and grouped, thus resulting in three groups of fractions.

Based on the TLC chromatogram purity test, the results showed a single stain on every kind of eluent (Table 2).

Table 2. Eluent and Rf Value

Figure	Eluent	Rf value
A	n-hexane : ethyl acetate (6 : 4)	0.4
B	acetone : ethyl acetate (4 : 1)	0.875
C	dichloromethane : acetone (9 : 1)	0.425

From the results it can be concluded that compound **2** separation results in a relatively high purity that can be further analyzed by UV-Vis, IR spectrophotometer, and GC-MS spectrometers.

3. **Data Analysis**

UV-Vis Spectrophotometer

UV-Vis spectrophotometer used to determine the maximum wavelength of compounds underanalysis. The results of measurements of these compounds in methanol showed the maximum absorption of wavelength at 220.80 nm and 400.20 nm.

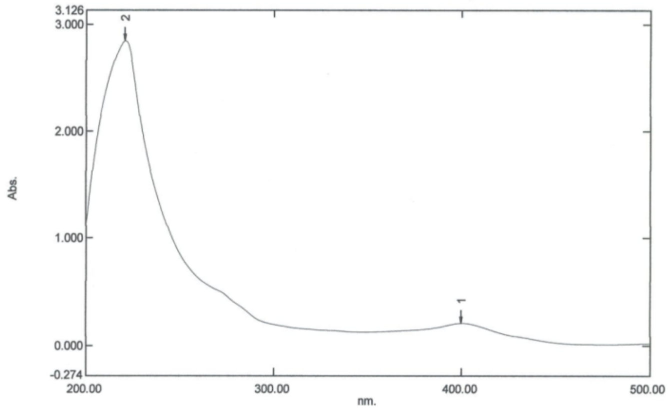


Figure 2 UV-Vis spectra of isolated compounds

IR Spectrometer

Infrared spectroscopy (IR) used to determine the presence of functional groups contained in the isolated compounds. The analysis of IR spectra of isolated compounds are shown in Table 3.

Table 3. Results of the analysis of the IR spectra

Wavelength(cm^{-1})	Estimated Group
3464.15	O-H Carboxyl
2970.38 ; 2931.80 and 2877.79	C-H aliphatic
1743.65	C=O Carbonyl
1458.18 and 1381.03	C-H aliphatic
1265.30	C-O ester

GC-MS Spectroscopy

The GC-MS spectroscopy method was used to determine the molecular weight and structure of the isolated compounds. The result of analysis with GC-MS spectroscopy is shown in Figure 3, while the GC-MS chromatogram data of isolated compounds are presented in Table 4.

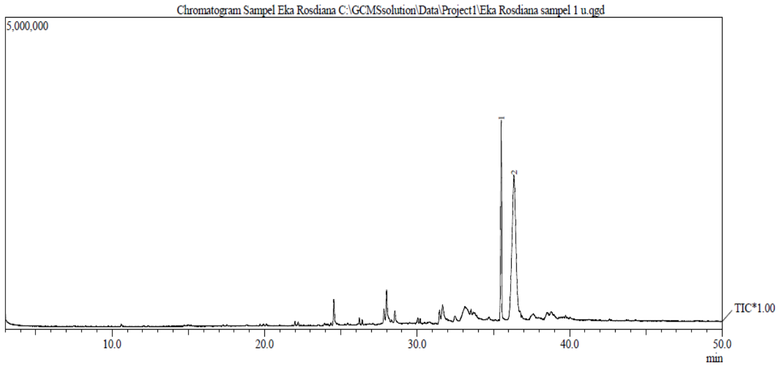


Figure 3. GC-MS Spectroscopy of isolated compounds

Table 4. GC-MS Chromatogram Data of isolated compounds

Peak no	Rt (second)	% Area	Estimated compound	SI
1	35.520	30.47	bis (2-ethyl-hexyl) phthalate	95
2	36.347	69.53	estran-3-one, 17-(acetyloxy)-2-methyl-(2α.,5α.,17β)	75

Based on the above chromatogram, the mass spectra of peak 1 has a base peak of 149 with a molecular weight of 390 and indicates the similarity index (SI) with the fragmentation patterns of bis (2-ethyl-hexyl) phthalate compound of 95. The mass spectrum of the isolated compound is shown in Figure 4.

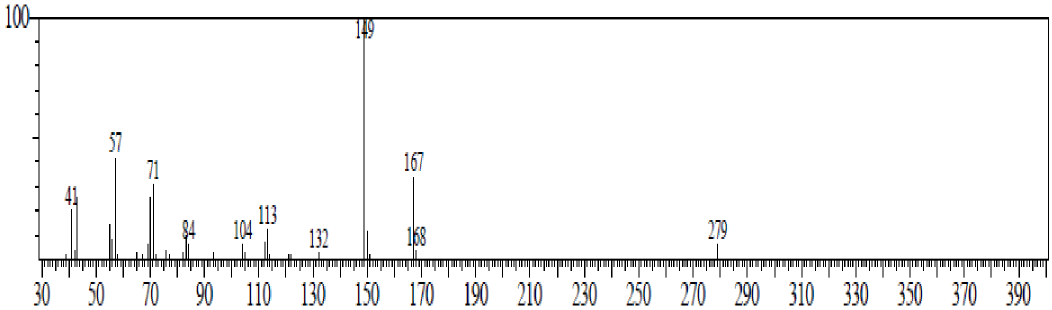


Figure 4. Mass Spectrum of Peak 1 of the isolated compound

The mass spectrum of Peak 2 has a base peak of 43 with a molecular weight of 332 and indicates the similarity index (SI) with the fragmentation patterns of estran-3-one, 17-(acetyloxy)-2-methyl-(2α.,5α.,17β) compound of 75. The mass spectrum of the isolated compound is shown in Figure 5.

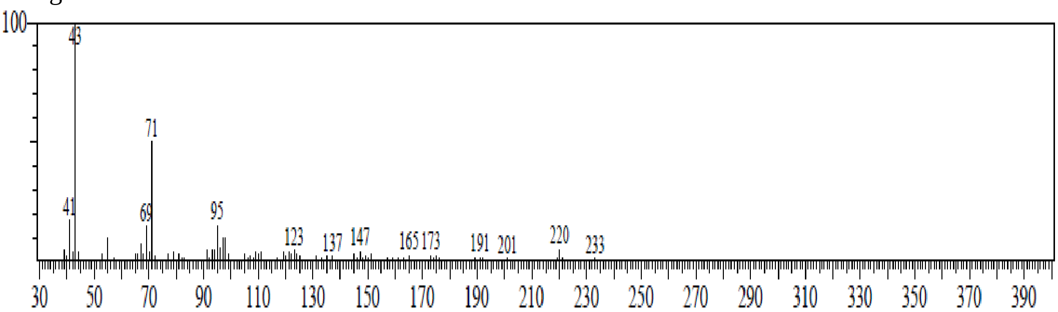


Figure 5. Mass Spectrum of Peak 2 of the isolated compound

The aim of this analysis with GC-MS spectroscopy is to determine the purity of isolated compound and determine the molecular weight fragment of its functional group. GC-MS spectroscopic data generated from the isolated compound two peaks. The highest peak is the Peak 1 with an abundance of 30.47% and a retention time of 35.520 minutes and has the m/e of 390. Peak 2 has an abundance of 69.53% with a retention time of 36.347 minutes and has the m/e of 332. Peak 2 is then the dominant compound because peak 2 has a greater abundance percentage than Peak 1.

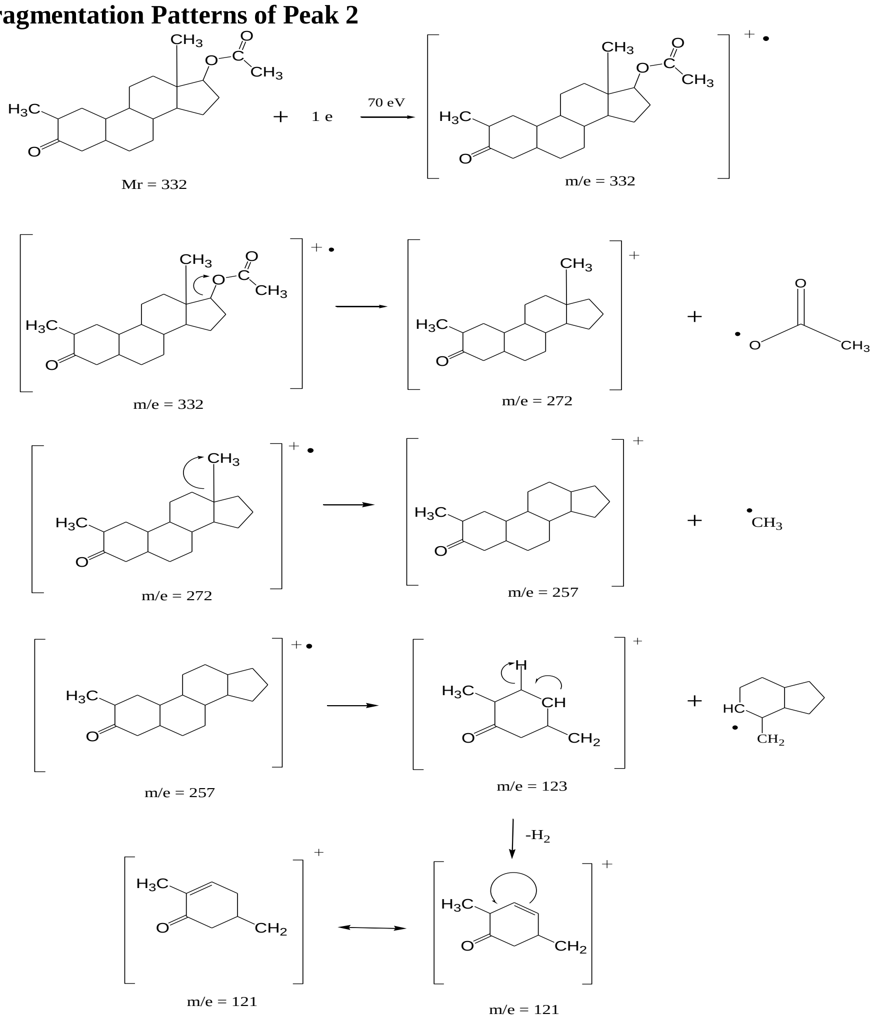
Regarding the mass spectra (M^+) 390 in Peak 1 and (M^+) 332 in Peak 2, there is no peak in mass spectra; this is because the particles had shorter life time and had no time to reach the ion collector so that molecule could not be detected and only the products of fragmentation showed the peak in mass spectra (Fessenden and Fessenden, 1986).

Peak 2, with an abundance of 69.53% and m/e of 332, has similarities with 17β-(acetyloxy)-2α-methyl-5α-estran-3-one. This is supported by the fact that SI of 75 as well as the fragmentation pattern and m/e mass spectra which appeared were similar to the fragmentation pattern and m/e mass spectra of 17β-(acetyloxy)-2α-methyl-5α-estran-3-one. However, in this case, the similarity index was not very big.

Peak 1, with an abundance of 30.47% and m/e of 390, has similarities with bis (2-ethyl-hexyl) phthalate. This is supported by the fact that SI of 95 as well as the fragmentation pattern and m/e mass spectra which appeared were similar to the pattern of fragmentation and m/e mass spectra of bis (2-ethyl-hexyl) phthalate.

The fragmentation patterns of isolated compounds found in the analysis were 17β-(acetyloxy)-2α-methyl-5α-estran-3-one and bis (2-ethyl-hexyl) phthalate. The fragmentation patterns of 17β- (acetyloxy) -2α-methyl-5α-estran-3-one are 332 (M^+), 272, 257, 121, 94, 81, and 43. The fragmentation patterns of 17β-(acetyloxy)-2α-methyl-5α-estran -3-one are shown in Figure 6.

Fragmentation Patterns of Peak 2



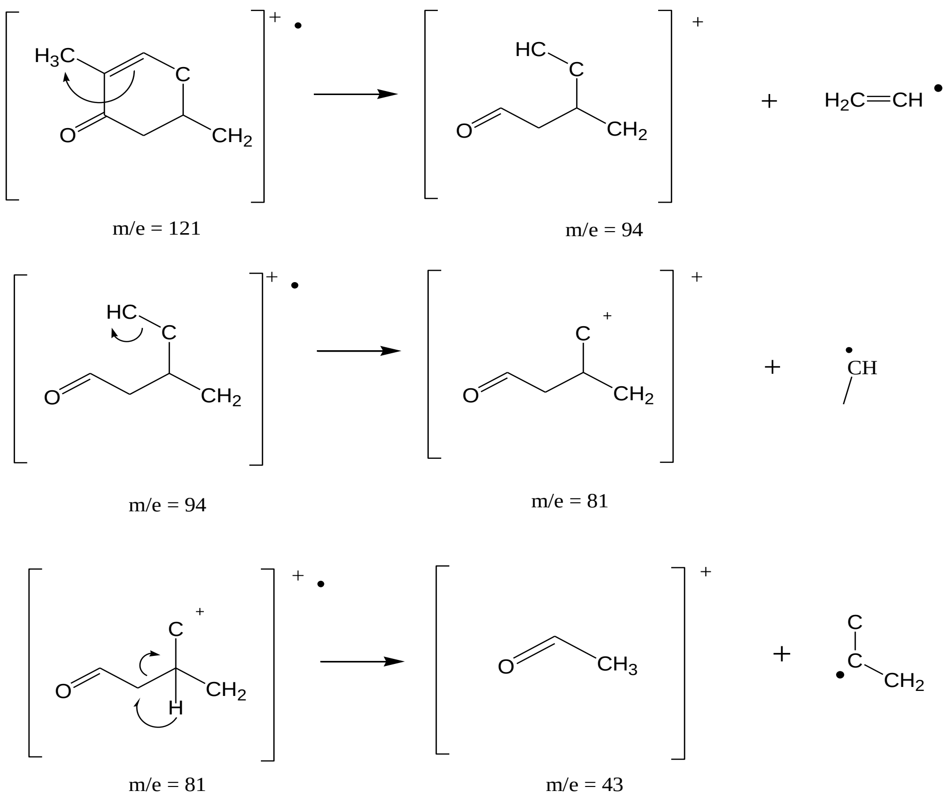


Figure 6 . Fragmentation Patterns of 17 β-(acetyloxy)-2α-methyl-5α-estran-3-one

Meanwhile, the fragmentation patterns of bis(2-ethyl-hexyl) phthalate are 390 (M^+), 279, 168, and 149. The fragmentation patterns of bis (2-ethyl-hexyl) phthalate are shown in Figure 7.

Fragmentation patterns of Peak 1

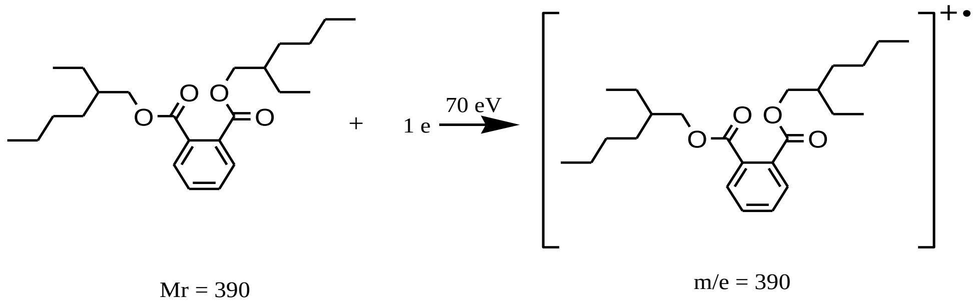


Figure 7. Fragmentation of Peak 1

The extraction method in this study is macerated by dissolving the powder with methanol solvent. Methanol was chosen to be the solvent because it is widely used in the extraction process and is able to dissolve all the preliminary and secondary metabolites. In addition, methanol also has a low boiling point of 64.7°C, so that it will be easily evaporated.

As much as 0.5 kg *KembangBulan* leaf powder was macerated using approximately 1 litertechnical methanol for 2 x24 hours long, while being shakenoccasionally. The powder that has been macerated remaserasi process is done only once at the same time. The methanol extract was then separated from *KembangBulan* leaf powder and concentrated using Buchii evaporator to obtain a concentrated methanol extract as much as 215 mL.

Separating the Chloroform Extract using Gravity Column Chromatography (GCC) Method

The separation process was conducted by using gravity column chromatography (GCC). Before processing, the column should be packed first, and the extract used should be as much as 1.00 grams, because the diameter of the column was just 2 cm wide. The solvent used in this process was selected by *trial and error*method, with two solvents mixed by TLC. The TLC resulted in an appropriate eluent i.e. a mixture of n-hexane and ethyl acetate in a ratio of 6: 4. In 20 bottles of fraction were obtainedfrom this process, each of which were then identified using the TLC, eluted using a mixture of n-hexane and ethyl acetate with the ratio 6: 4.

Furthermore, the concentrated methanol extract was partitioned using chloroform. The partitioning process aimed to separate compounds based on the polarity of the more-specific secondary metabolites. The concentrated methanol extract was partitioned using n-hexane and then the rest of the methanol in this partition was again partitioned using chloroform. The tools used in this partitioning process was separating funnel. The partitioning process was repeated three times, each with the ratio of 6:4 between n-hexane and ethyl acetate. The partitioning process resulted in as much as 215 mLethyl acetate fraction. Then this fraction is evaporated to produce concentrated chloroform fraction as much as 110.6 mL.

The next stage was the separation process using chromatographic techniques with Vacuum Liquid Chromatograph,GravityColumn Chromatography (GCC), and Thin Layer Chromatography (TLC). Prior to the separation, the *ethyl acetate* fraction concentrated in advance using silica gel was impregnated intended that the compound in the fraction bound to the silica gel so that secondary metabolites can be eluted only with a suitable solvent in the separation process with GCC. Thin Layer Chromatography (TLC) function to determine the appropriate eluent to be used in the process of GCC, as well as to test the purity of the isolated compounds.

The TLC resulted in the appropriate eluent, i.e. a mixture of n-hexane and ethyl acetate with a ratio of 6:4. This process generated 20 bottles of fraction, which were then identified with TLC from each bottle of fraction using a mixture of n-hexane and ethyl acetate with the ratio of 6:4. The 20 bottles of fraction resulted from TLC were grouped based on the pattern of separation and the same value of Rf, so that there were 5 groups/fractions, namely I (1-2), II (3-4), III (5-8), IV (9-13) and V (14-20). Group/fraction V (14-20) was assumed to produce a single node so that this group of bottles was identified to be further examined.

From fraction V (14-20), the results were then gathered into one and dried, in order to obtain as much as 0.1 gram. This fraction showed a single node on the chromatogram, so that a further test for purity using TLC with three kinds of eluent i.e. n-hexane : ethyl acetate (6:4) (fraction A), acetone : ethyl acetate (4:1) (fraction B), and dichloromethane : acetone (9:1) (fraction C).

Separation with Vacuum Liquid Chromatography clicking to use tools such as a vacuum pump to accelerate the rate of the eluent. Eluent used include 100% n-hexane, n-hexane: *ethyl acetate* with the ratio of 6:4; 4:1; 9:1, *ethyl acetate* 100%, and acetone100%. Eluent-column eluent is passed on by the increase in polarity then vacuum and collected in bottles fractions. Thus obtained 20 bottles fraction, the fraction of each bottle is in-identification using Thin Layer Chromatography (TLC) with a mixture of n-hexane eluent: *ethyl acetate* in a ratio of 6:4. Based on the results of TLC Rf price similarity then 8 bottles fractions were grouped into two fractions, namely fraction A, fraction B and Fraction C. Based on the chromatogram, selected fractions A for further separation using column chromatography Gravity 1.

The separation process with CCG 1 aims to obtain a more pure fractions with a single stain on the TLC plate. Eluent used in the separation process is a mixture of n-hexane: *ethyl acetate* in a ratio of 6:4. This process produces 20 bottles fraction, then be identified using TLC techniques. Based on the results 1 TLC chromatogram, taken one of the most dominant faction group and have the same price of Rf (0.2) is the fraction F6A. These groups combined and concentrated fractions and tested for purity using TLC techniques. The purity of the test is known that has not produced a single stain on a TLC plate.

Separation process of CCG2 using the eluent a mixture of n-hexane: *ethyl acetate* in the ratio of6:4. In this separation process produces 20 bottles of fractions, then identified using TLC techniques. Furthermore, the fractions were grouped by similarity price Rf and obtained two groups of fractions. Then the selected group of the most dominant fraction is the fraction of Rf 0.45. These groups combined and concentrated fractions and tested for purity using TLC techniques.

Test purity by TLC technique using the eluent mixture of chloroformwith 3 kinds of comparisons among others (6:4), (4;1), (9:1). The value of Rf calculations on this test can be seen in Appendix 2. A relatively pure compounds in the yellow-green room temperature.

Analysis using UV-Vis, IR spectrometer, and GC-MS spectrometer

Analysis with UV-Vis spectrophotometer aimed to investigate the electronic transition and the chromophore group in the identified compounds. Chromophore group is a functional group that can absorb ultraviolet radiation near the visible region. Solvent used in this analysis was methanol, since methanol can dissolve the sample well and do not absorb ultraviolet radiation. The results of the analysis using UV-Vis spectrophotometer showed the maximum wavelength (λ_{maks}) at 402.0 nm and 664.5 nm.

The Infrared (IR) spectrometer analysis aimed to determine the functional groups contained in the isolated compounds. Based on the IR spectra of isolated compounds showed an -OH group at 3429.59 cm^{-1}, CH aliphatic at 2951.62 $cm^{-1}$and 2839.31 cm^{-1}, group C=C in 1644,01cm^{-1}, -CH3 in 1405.86 cm^{-1}, and C=O at 1018.12 cm^{-1}.

IV. CONCLUSION

Based on the discussion above some conclusions can be drawn as follows:

1.Analysis compound in the leaves KembangBulan (Tithonia diversifolia) using a UV-Vis spectrophotometer showed the maximum wavelength (λmaks) at 220.80 nm and 400.20 nm. Based on the analysis of IR spectrometer it is known that the compound contains -OH group, aliphatic CH, the C=O ester group, and the C=C double bond.

2.Mass spectrum of GC-MS shows the m/e value of 332 which is similar to 17β-(acetyloxy)-2α-methyl-5α-estran-3-one with the abundance of 69.53%. The secondary metabolite compound which can be isolated from chloroform fraction of KembangBulan (Tithonia diversifolia) leaves is steroid.

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C – 06

Development of $LiMn_2O_4$ Cathode Materials for Lithium Battery

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Abstract— The use of batteries in daily life is so common today that cell phones, digital cameras, laptops, up to hybrid rely on batteries as the driving source, making the prospects of batteries as energy source very high. Among the many types of batteries, lithium-ion battery is a type that researchers and industries are keen on, due to the fact that in addition to having a high power, these batteries are lightweight and are capable of multiple usage. The rapid development of technology takes lithium battery to a level that it is capable of producing higher energy. Manganese dioxide (MnO_2) and its derivatives are the battery materials widely used as positive electrode for lithium primary and rechargeable batteries. $LiMn_2O_4$, one of MnO_2 derivatives, is one of the main candidates of positive electrode material for lithium batteries because it is widely available, cheaper and environmentally friendly. The following article discusses the lithium battery and an appropriate, effective and efficient method of synthesis to obtain $LiMn_2O_4$ for positive electrode material of lithium batteries.

Keywords: *lithium battery, $LiMn_2O4$, cathode materials*

I. INTRODUCTION

The use of batteries in daily life is so common today. Cell phones, digital cameras, laptops, up to hybrid cars, all of which require a battery as a driving source, thus the battery prospect to become a future energy source is very strategically and economically. Among the many types of batteries, which a lot of attention is a lithium battery. Besides having a high power, these batteries are lightweight and can be used many times (rechargeable). With the rapid development of technology, the lithium battery that is supposedly able to produce higher energy become indispensable.

Manganese dioxide (MnO_2) is a material that is widely used as a battery cathode materials for lithium primary batteries and rechargeable batteries. In addition, MnO_2 is also considered the most potential to become the next generation of cathode materials in lithium batteries because of the availability of abundant, low-cost and environmentally friendly. MnO_2 electrochemical properties is determined the crystal structure and morphology of the oxide. MnO_2 contained in several polymorphic forms, namely α-, β-, γ- and δ-MnO_2. During this time of the four polymorphic forms, the α-MnO_2 and β-MnO_2 receive special attention as cathode materials for lithium batteries for their hallway 2x2 in a crystal lattice α-MnO_2 (Yang et al., 2008) which is considered to facilitate the accommodation and transport to enter lithium ion.

Derivatives of MnO_2 is $Li_{1+x}Mn_{2-x}O_4$. These compounds identified because it has a metal frame/ oxygen with continuous tetrahedral cavities can be passed to the lithium ion. Framework Mn-O synonymous with λ-MnO_2 phase and containing an array of octahedral which ends meet and form a corridor MnO_6 1x1 through the structure perpendicular in three directions, which turned out to be more effective than lithium-ion bypassed α-MnO_2 and β-MnO_2.

II. DISCUSSION

The development of sources of renewable energy becomes absolutely necessary [1]. Among the new and renewable energy source that has been developed is a lithium battery [2]. The development of battery technology is the fastest primarily for batteries for electric vehicles and it has become the foundation determines the design, characteristics, performance, and cost in the process of development of automotive technology. The rapid development of lithium batteries has allowed their dynamic performance at the same potential in capacity and variety of vehicles. In addition, the increasingly rapid development of lithium battery driven by a static electronic equipment becomes portable. The lithium battery has the potential to have an energy value of 3.000 W/kg and be the energy system solutions lightweight but powerful in the future.

The use of mixed oxides of cobalt/nickel lithium to replace the lithium cobalt oxide as the cathode material for lithium battery standard has been widely considered. The use of nickel oxide/cobalt /aluminum-lithium as cathode materials in lithium-ion batteries for hybrid electric vehicles have been reported [3]. A related system is a layer $Li_x(MnNi)O_2$ with x> 1. This species does not undergo deoxygenation when discharging, which poses a risk of fire and explosion risks are low and produce a very large capacity in the range of 2.5 to 4.6 V. The energy output> 1 Wh g^{-1}, with the potential to limit point and the ionic liquid electrolyte operation > 40^{o}C can improve the performance of lithium battery cathode though still needs further research [4].

A. Lithium-Ion Batteries

The composition of the structure of the lithium-ion battery can be seen in Figure 1. The lithium-ion battery consists of an anode, separator, electrolyte and cathode. At the cathode and anode generally consists of two parts, namely the active material (entry-exit lithium-ion) and a part of electron collector (collector current). Electricity generation process in the lithium-ion battery as follows: If the anode and cathode are connected, the electrons flow from the anode to the cathode, along with the electricity flowed. On the inside of the battery, lithium ion release process occurs at the anode, then these ions move toward the cathode through the electrolyte. At the cathode cobalt oxidation number changes from 4 to 3 due to the influx of electrons and lithium ions from the anode. The process of recharging lithium batteries is the reverse of this process. Of the various types of metal, lithium is a metal that promises to be the anode. Lithium has the most negative standard potential value is -3.0 V, the lightest with an atomic weight of 6.94 g, so when used for the anode can produce high energy capacity [5].

The lithium-ion battery can work as an energy storage device by converting electrical energy into electrochemical energy. The basic working principle of a lithium-ion battery is shown in Figure 2.1. There are three main components in lithium-ion battery system: cathode, the anode, and electrolyte. For lithium-ion battery systems today, both the cathode and the anode intercalation material. Oxides of transition metals in the cathode (graphite on the anode) is the host so that Li can be intercalated. At the time of charging, ions Li is currently on the cathode move through the electrolyte and be intercalated at the anode. Meanwhile, the electrons also move from the cathode to the anode through the outer side of the current collector to form an electric circuit. The chemical potential of Li in the anode is much higher than in the cathode so that electrical energy is stored in the form of electrochemical energy. The process of discharging a reversal of the charging process, in which an electrochemical energy released in the form of electrical energy. The cathode and anode are separated by a separator, the microporous membrane that allows the electrolyte to penetrate and prevent shorting between two electrodes [6,7]. In cycling the first to be formed-solid-electrolyte interphase (SEI), the layer formed on the electrode surface due to the decomposition of the electrolyte at extreme voltage (<1.2 V or> 4.6 V. In a lithium-ion battery technology at this time, the cell voltage and capacity mainly defined by the cathode as a limiting factor for the rate of transport Li [8].

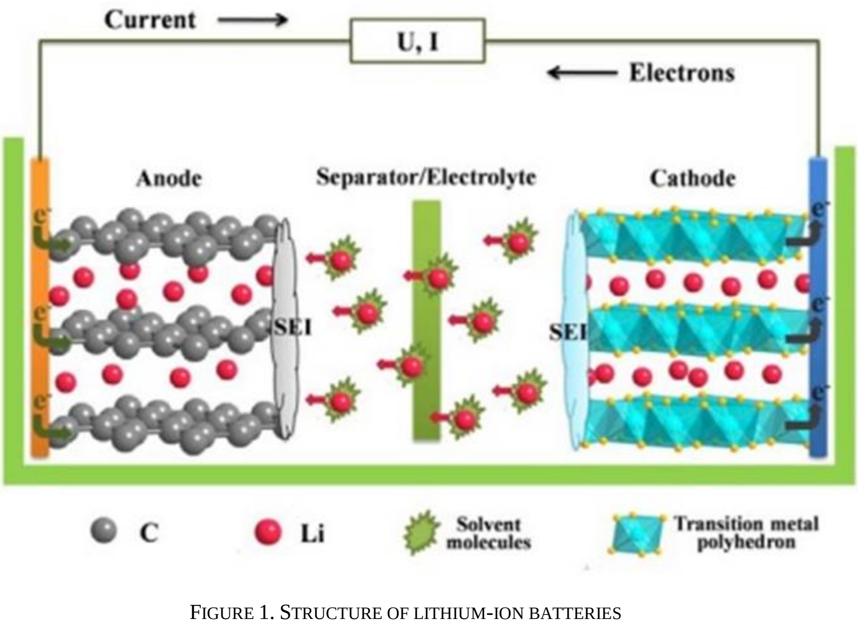

FIGURE 1. STRUCTURE OF LITHIUM-ION BATTERIES

B. MnO_2 and its Derivatives ($Li_{1+x}Mn_{2-x}O_4$)

Among the common transition metals, manganese is the one that has the crystal structure of oxides, oxy-hydroxides and hydroxide different in the largest quantities. To explain the structure of the manganese complex involves two main factors associated with the electronic structure of the ion Mn^{n+}(Jahn-Teller effect) and associated with many of redox reactions involved in the system Mn-O-H_2O. This raises a variety of materials with a wide range of composition and structure of valence manganese [9]. Mn oxidation number is +2, +3, +4 +6 and +7 which the most stable oxidation is between 2 and 4 [10].

Oxides of MnO_2

Despite having a small ionic radius is estimated at 0.53 Å [11] for the stability of the tetrahedral sites, Mn^{4+} stable in octahedral phase for electronic d^3 configuration [12]. All MnO_2 oxide structures can be explained by the different placement of the octahedral sites in the network Mn^{4+} oxygen atom. The easiest way to describe this structure is to consider MnO_6 octahedral assembly. MnO_2 oxides are classified into two main categories according to the criteria in crystallography and chemical composition is by adjusting the stoichiometric oxide MnO_2 and of the shape of the cavity.

β-MnO_2 (Pyrolusit)

Type MnO_2 most solid and stable is a β-MnO_2. β-MnO_2 crystallized in the form of tetragonal (a = 4.40 Å, b = 4.40 Å and c = 2.85 Å) with space group P42/*mnm*. β-MnO_2 crystal structure of rutile type. MnO_6 octahedral edge forming a single chain of infinite and parallel to the c axis. Each channel is connected to four octahedral chains around it to form a corridor (1x1). This structure can be explained by the hexagonal arrangement of oxygen that the meeting is slightly distorted octahedral in which one of the two sites was occupied by Mn^{4+} [13]

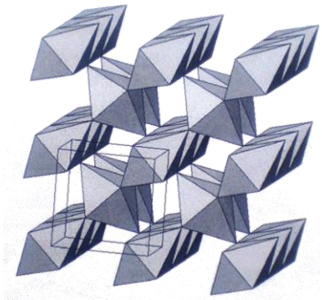

FIGURE 1. STRUCTURE OF β-MnO_2

Ramsdellite

Manganese and oxygen atoms in the modification ramsdellite of MnO_2 occupy the same crystallographic site with aluminum and oxygen atoms in the structure of diaspore (AIOOH). Ramsdellite crystal structure is very similar to pyrolusite except that the single chain octahedra in β-MnO_2 replaced by a double chain in ramsdellite. The hallway on the c axis of the orthorhombic structure (a = 4.46 Å, b = 9.32 Å, c = 2.85 Å) has a greater dimension (1×2) compared with β-MnO_2. Ramsdellite cell volume about twice the volume of β-MnO_2 cells. Such as pyrolusite, hallway ramsdellite (1×2) is too small to allow any cations other than protons or Li^+ [13].

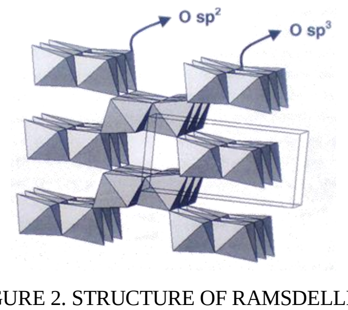

FIGURE 2. STRUCTURE OF RAMSDELLITE

γ-MnO_2 (Nsutite)

The oxygen atom in the γ-MnO_2 formed hexagonal symmetry with a = 2.78 Å, b = 2.78 Å and c = 4.44 Å. As in pyrolusit or ramsdellite, manganese atoms occupy half of the octahedral voids in this matrix. The only difference between pirolusit and ramsdellite is the arrangement of atoms in the b axis ramsdellite. Arrangements of atoms in a and c axes are very similar. Differences β-MnO_2 and ramsdellite only in the composition of manganese atoms, which form a single chain of edge sharing octahedra in β-MnO_2, and a double chain in ramsdellite. γ-MnO_2 crystal structure is often referred to as intergrowth of pyrolusite and ramsdellite with a corridor (1×1) and (2x2) [13].

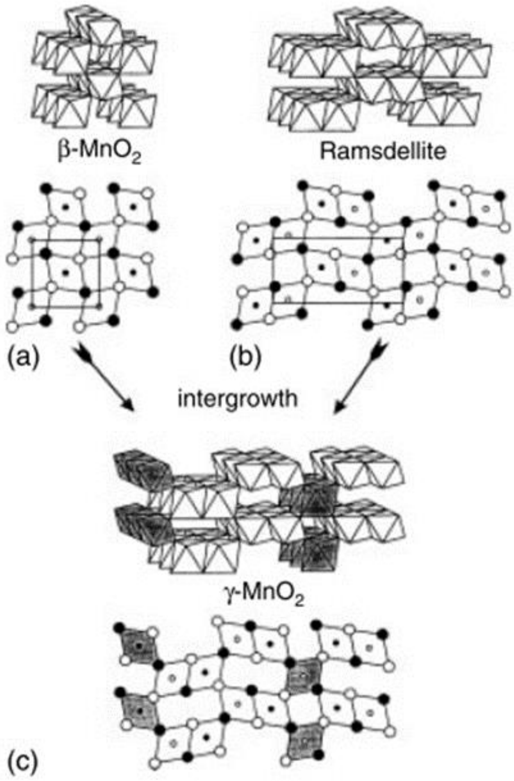

FIGURE 3. STRUCTURE OF γ-MnO_2

λ- MnO_2

This oxide spinel structure. These structures crystallize in a cubic system *Fd3m* with lattice parameters a = 8,029Å. This structure is derived directly from spinel structure of $Li_{1+x}Mn_{2-x}O_4$ containing an array of octahedral form the hallway (1x1) along the three crystallographic directions (110) similar [14]

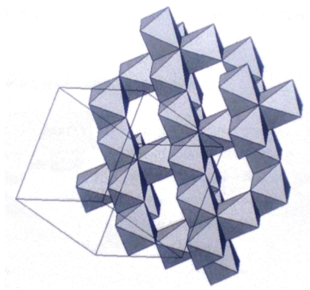

FIGURE 4. STRUCTURE OF γ-MnO_2

Network stability AB_2O_4 spinel associated with the insertion of lithium has been demonstrated experimentally in the 1990s, among others, Fe_3O_4, Mn_3O_4 and $LiMn_2O_4$ [15,16]. $LiMn_2O_4$ phase is characterized by oxygen, which is subject to a continuous network of tetrahedral gap accessible lithium ion. Order Mn-O is synonymous with λ-MnO_2 phase and consists of an octahedral arrangement of the edges forming the hallway MnO_6 (1x1) through the structure in three perpendicular directions.

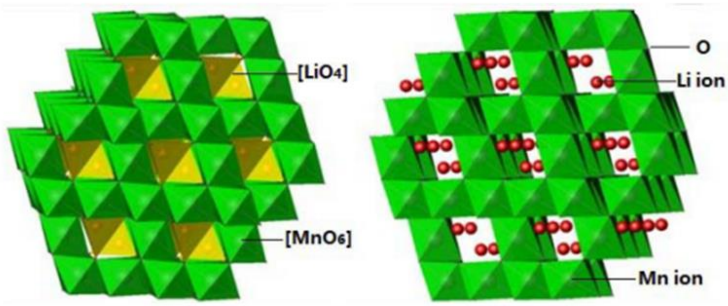

FIGURE 5. SPINEL $LiMn_2O_4$

The oxygen atom occupies the position 32 cubic crystallographic lattice to form a meeting at which the ions Mn^{3+}/Mn^{4+} and Li^+ respectively 16d octahedral and tetrahedral sites 8a. In this configuration, tetrahedral LiO_4 being exchanged each of their sides by empty octahedral sites 16c. Cationic distribution network is $Li_{tet}.[Mn_2]_{oct}.O_4$

When this material is used as the cathode of the lithium battery, lithium ions can be easily extracted in its structure during charging, then fed back during the release. But a significant decrease in the ability of this material can occur when used repeatedly [17,18,19]. Some causes have been advanced to explain this phenomenon

- The effects of strong oxidation of λ-MnO_2 phase associated with electrolyte
- The disproportionation Mn^{3+} to Mn^{4+} and Mn^{2+}
- Modify the structure of ion Mn^{3+} (Jahn-Teller effect)

Substitution of manganese sites 16d by elements with lower valence such as lithium will be able to minimize these effects and to improve performance and better cycling [20]. This causes excess lithium materials of general formula $Li_{tet}.[Mn_{2-x}Li_x]_{oct}.O_4$. The average rate of oxidation of manganese in $Li_{tet}.[Mn_{2-x}Li_x]_{oct}.O_4$ is greater than 3.50 which implies that only a portion of the lithium can be extracted electrochemically. As a result, the extraction of Li^+ ions in the structure against which the oxidation of Mn^{3+} ions into Mn^{4+}. The number of Mn^{3+} ions that can be provided is as much as the intrinsic capacity of these materials. Therefore, there is a relationship between capacity and maintenance materials for use in the long term. Phase $Li_{1+x}Mn_{2-x}O_4$ forming solid solutions between $LiMn_2O_4$ (x=0) and $Li_4Mn_5O_{12}$ (x=1/3), represented by a segment in the phase diagram of λ-MnO_2-MnO-Li_2MnO_3 (Figure 6) taken from the diagram Li-Mn-O (Figure 7). In the diagram λ-MnO_2-MnO- Li_2MnO_3, lithium intercalation reactions indicated by a dotted line. Segment $Li_4Mn_5O_{12}$-Mn_3O_4 spinel phase corresponds to a stoichiometric as well as forming the boundary between two areas of potential intercalation (3 Volt and 4 Volt) each associated with insertion in octahedral and tetrahedral sites.

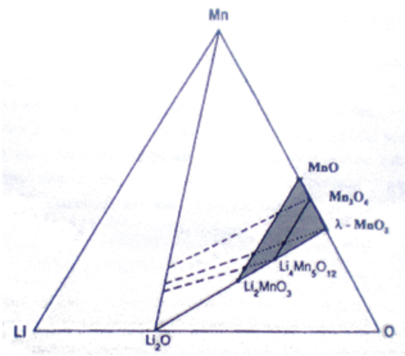

FIGURE 6. PHASE DIAGRAM OF Li-Mn-O [16]

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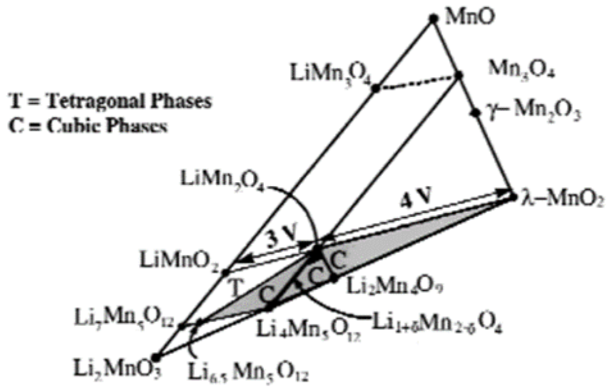

FIGURE 7. PHASE DIAGRAM OF λ-MnO_2 - MnO - Li_2MnO_3 [16]

C. *Recent Progress in Synthesis of $LiMn_2O_4$*

Synthesis of compound $LiMn_2O_4$ influenced by many things such as the type of precursor, synthesis methods, the calcination temperature, time (calcination time), mole composition between the precursors and sediment material. Kind of a good precursor will affect the results of the crystals formed [21]. The method used aims to obtain a compound $LiMn_2O_4$ with the most stable geometric phase so that it can be applied as a battery material that can be used for alternative energy sources in the future. To obtain a pure crystal $LiMn_2O_4$do calcination at a certain temperature so that there are differences in the crystal structure of $LiMn_2O_4$ formed. Long time calcination also influences the crystals formed. In stoichiometry, the composition of the precursor moles is important to note because it will affect the results of synthesis.

Phase geometry MnO_2 compound known to fluctuate based on temperature. Calcination of the compound $LiMn_2O_4$ in the polymer matrix is expected to maintain the spinel phase to date this compound returns to room temperature, the geometric phase is not transformed by the influence of temperature. Variations in temperature calcination at 400^{o}C, 500^{o}C, 600^{o}C, 700°C, 800^{o}C and 900^{o}C expected to be used to determine the compound nanocrystalline $LiMn_2O_4$ that have the most purity and high crystallinity.

Synthesis of $LiMn_2O_4$ to do with the method of deposition of the polymer matrix with or without using a base [22,23]. Phase spinel $LiMn_2O_4$ important to be stabilized in order to maintain the oxygen conductivity. Several methods can be used to maintain the spinel phase, among others, by sol-gel method, method of condensing gas, as well as methods of spray pyrolysis, but a variety of methods and processes that are known to have a variety of shortcomings, among other expensive and not applicable commercially [24].

Deposition method with a base polymer matrix can be done with reflux technique, which is based on the vapor-liquid equilibrium, where the boiling point of the liquid is sufficiently effective for a long time because the temperature of the reaction mixture collection. The advantage of this technique is that the process can be left out for long periods of time without the need to add more solvent so as to save the use of solvents for solvent would evaporate condensed back [25]. Reflux technique is widely used to produce single crystals with a gain of temperature and pressure can be controlled, so that the structure and morphology of the nanotubes can be engineered.

The polymer used is polyethylene glycol, glycerol, 1,2 propanediol, 1,3 propanediol, 2,3 butanediol and 1,4 butanediol. In this method of forming the polymer matrix, particles of compounds $LiMn_2O_4$ evenly dispersed in the layers of the matrix so that the pore size, the hallway between the particles are arranged into homogeneous. Polymeric compounds selected for addition of these compounds is quite cheap, relatively small quantities (±10 ml) is sufficient to form a matrix to disperse the oxygen atoms in the particle $LiMn_2O_4$ more regular basis.

Synthesis of $LiMn_2O_4$ also is performed by hydrothermal method [26]. This method is ideal for nanoparticle synthesis because the resulting crystals have high purity, stoichiometry can be controlled, the particle size can be limited, controlled morphology, uniform, high crystallinity [27]. Synthesis of $LiMn_2O_4$ with the hydrothermal method is usually carried out in autoclaves types Morey. The advantages of this tool are used Teflon as a reactor. Synthesis conditions can be carried out in the temperature range below 200^{o}C and pressures below 100 bar (T = <200^{o}C, P <100 bars). Pressure and temperature conditions can thus be achieved with the use of autoclaves walled Teflon. The use of Teflon helps to optimize the purity and homogeneity of $LiMn_2O_4$ nanoparticles. Although using a low temperature is 150^{o}C though, is enough to get $LiMn_2O_4$ with high crystallinity and a uniform particle size through the course with hydrothermal correct media.

Characterization of $LiMn_2O_4$ synthesis product can be analyzed by FTIR, SEM, TEM and XRD. Crystal structure determination using powder diffraction is very interesting for scientists because it has great potential to improve the design, synthesis, and characterization of nanoscale materials and biotechnology. In chemical analysis, X-ray diffraction can be used to identify the unknown solid substance, determining the purity of a crystal and so forth. The crystal structure will be more easily determined by X-ray diffraction method. Application of X-rays is unique for each crystal so that solids can be effectively determined by comparing the standard diffraction patterns. Standard diffraction pattern which is commonly known is the JCPDS file (Join Committee on Powder Diffraction Standards) or file ASTM (American Society for Testing Materials) which covers 35,000 types of crystals and always increased an average of 2,000 per year [23].

Meanwhile, for the characterization of the microstructure performed ab initio ie computerized optimization structures, for large systems containing thousands of atoms [28].

III. CONCLUSION

Manganese dioxide (MnO_2) and derivatives $LiMn_2O_4$ the battery materials are widely used as cathode materials for primary batteries and lithium batteries rechargeable. This is because MnO_2 considered the most potential for the cathode material due to its availability of abundant, low-cost and environmentally friendly. MnO_2 electrochemical properties are determined the crystal structure and morphology of the oxide. Synthesis of compound $LiMn_2O_4$ is influenced by many things such as the type of precursor, synthesis methods, the calcination temperature, time (calcination time), and mole composition of the mole precursors. Characterization of $LiMn_2O_4$ synthesis product can be analyzed by FTIR, SEM, TEM and XRD. For characterization of the microstructure performed ab initio ie computerized optimization structures, for large systems containing thousands of atoms.

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C – 07

MODIFICATION OF LAC INSECT SECRETION BY USING ADIPIC ACID AS MATRIX IN PREPARATION OF BIOCOMPOSITE

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Abstract— Secretion of lac insect was used as matrix lac (matlac). Matrix phase was changed from solid to liquid by using an ethanol p.a. as a solvent by mass ratio of matlac-solvent in composition 1:2, so the matrix distributed homogenly. Matlac was modified by adipic acid with concentration 5, 10, 15, 20, and 25%, respectively. Polymerization was conducted at 50^0C with agitation during 2 hours. Matrix matlac of insect secretion after modification was characterized in some properties e.g ;the intrinsic viscosity by Ostwald viscosimeter, functional group by FTIR spectrophotometer, and thermal properties by Differential Thermal – Thermogravimetric Analyzer. Mechanical properties of biocomposite from modified natural matrix of lac insects with reinforcement ramie fibers were characterized by tensile tester based on standard ASTM type IV. The result of this research showed that modificated matrix has very high yield between 98.62% to 99.24%. The addition of 5% adipic acid 5 can produce matlac matrix with high viscosity of 77.08 cP. Addition 5% of adipic acid into matrix of lac insects didn't change the functional group qualitatively but can decrease the thermal stability of matlac. Strength at break of biocomposite was 14.299 MPa, elongation at break was 1.02%, and modulus Young was 1391.877 MPa.

Keywords: *adipic acid, biocomposite, matlac matrix, secretion of lac insect on Kesambi tree*

I. INTRODUCTION

Composites consist of two or more distinct constituents or phases, which when married together result in a material with entirely different properties from those of the individual components [1]. Materials from renewable resources are being sought to replace not only reinforcement element but also the matrix phase of composite materials, thereby alleviating some of the sustainability issues associated with using synthetics in composites [2]. Natural fibers that can be used to manufacture biocomposites include banana fibers [3], coco fiber [4], sugar cane fibers [5], and fiber flax [6, 7].

Biopolymer has been developed as natural matrix for composites, such as starch, soybean, vegetable oil, and chitosan [8-14]. This is done because persistence of plastics in the environment, the shortage of landfill space, the depletion of petroleum resources, concerns over emissions during incineration, and entrapment by and ingestion of packaging plastics by fish, fowl, and animals have spurred efforts to develop biodegradable plastics [15, 16]. Production of biodegradable material is now widely expected to contribute to the solution of the problem, since biodegradable material would enter the material cycles in the environment.

Biocomposites have been the subject of international research since at least the mid-1990s and a number of practical applications are now emerging, including interior automotive components and housings for notebook computers [17, 18]. Commercial interest in manufacturing these products is driven by the derivation of the polymers from renewable sources as well as by their specific properties including biodegradability [16, 19, 20].

Biocomposite with natural matrix developed more rapidly because they are more environmentally safer. The natural matrix in this experiment was obtained from secretion of lac insect on Kesambi tree (Shellac). Shellac flea *Laccifer lacca* Kerr is a phytophagous insect, which lives on Kesambi tree (*Schleichera oleosa* Merr) [21]. During its life cycle, shellac flea secretes liquid known as LAK and has many uses, such as varnish/polish, food cover, drug capsule, cassette ribbon, etc. In 2005, Perum Perhutani produced 60.547 kg LAK pellets, but has not fulfilled market demand. The lac is resinous compound which has special properties: biodegradable, non-toxic, and provides immense employment opportunities [16]. Naturally, the soft-bodied lac insects produced a resinous secretion which protects them from adverse environment. The major constituent of lac is the resin and other constituent. Other constituents present were: dye, wax, sugar, proteins, soluble salts, sand, woody matter, insect body debris [23]. Shellac is also produced from lac insect (*laccifier lacca*) that has an attractive material and economically important species [22]. The secretion of lac insect on Albazia tree (ISA) as a candidate feasible biobased matrix for biocomposite with the main constituent aleuritic acid [16]. ISA disbursement method with aleuritic acid chemical structure can be done by using the solvent ethanol [23].

Reference study showed that the lac is secretion of lac insect. It is renewable, biodegradable versatile and has good bonding strength, non toxic resin, which leads great potency of lac as natural matrix for biocomposite. A feasibility of the matlac as natural polymeric matrix composite or green matlac composite reinforced by ramie-woven fiber has relatively the same tensile strength to the composite of polyester [6, 7]. The matlac matrix is well compatible with ramie, indicated by contact angle of about $30^{0(}$ [6]. The biocomposite potents to be a novel material from renewable resources. Biopolymer has been developed as natural matrix for composites, such as starch, soybean, and chitosan [9-14, 24].

Investigations were conducted to modification secretion of lac insect by esterification using adipic acid. The objective of this research was to modify and characterize of insect secretion on Kesambi tree as biobased material alternative for matrix composite, and also to prepare and study mechanical properties of biocomposite from modified matlac by adipic acid and ramie fiber.

II. METHODS

A. Materials

Natural matrix was prepared from secretion of lac insect that separated from Kesambi plant and collected. Ethanol p.a. from Aldrich Lab, Yogyakarta, Indonesia was used as lac solvent with composition 1:2. Secretion of lac insect is reacted with citric acid, the concentration of 5, 10, 15, 20, and 25% m/m.

B. Instrumentation

Yield of reaction product was determined with gravimetry technique by using balance. Intrinsic viscosity of insect secretion with and without modification was measured by using viscometer Ostwald in Organic Chemistry Lab. Yogyakarta State University, Yogyakarta. Infrared spectra were recorded on KBr pellets by using a Shimadzu FTIR spectrophotometer in Indonesia Islam University, Yogyakarta. Thermal properties of reaction product after modification were determined by using DTA-TGA analyzer in Leather Technology Academy, Yogyakarta. The mechanical properties of biocomposite from modificated natural matrix of lac insect secretion and ramie fiber were determined by using tensile tester in Faculty of Enginering, Yogyakarta State University.

C. Modification of matrix and Preparation of Biocomposite

Natural matrix was prepared by solving secretion of lac insect into ethanol p.a. at a room temperature with mass ratio of 1:2 for 6 hours. Natural matrix was referred as matlac (matric lac). Meanwhile, modificated matrix was prepared through esterification reaction between secretion of lac insect with adipic acid. Reaction was conducted at 50^0C with agitation during 2 hours. Afterward, modificated matrix was ready to be characterized and be used as matrix in preparation of biocomposite. Biocomposites were prepared from fiber ramie and modificated lac insect secretion by adipic acid with a comparison matrix of 40% and random fiber of 60%. Biocomposites manufacturing process was conducted at a temperature of 90° C and a pressure of 90 kgf/cm^2. Biocomposites were prepared by a hot press with heating at a temperature of 90 °C for 15 minutes. After the heating process, carried out a pressure of 90 kgf/cm^2 for 15 minutes, then cooled with a pressure of 90 kgf/cm^2 within 10 minutes.

D. Characterization of Matrix and Biocomposite

Matrix from secretion of lac insect before and after modification by using adipic acid is characterized i.e. yield by gravimetry technique, intrinsic viscosity by measuring flow time, functional group by using FTIR technique, and thermal properties by using DTA-TGA technique. The mechanical properties of biocomposite were characterized by using tensile tester based on standard ASTM type IV.

III. RESULT AND DISCUSSION

A. Yield of Matrix matlac from Modificated Secretion of Lac

Based on the data from Table 1 indicates that the product matrix of secretion of lac insect has a very high yield between 98.62% to 99.24%. The addition of adipic acid 25% into the matrix matlac of secretion of lac insect can produce the highest yield of the reaction product.

Table 1. *Yield* of Modificated Secretion of Lac Insect by Adipic Acid

Matrix matlac of secretion of lac insect with adding	***Yield* of matrix (%) at adding *modifier***				
	5%	10%	15%	20%	25%
Adipic Acid	98.62	99.06	98.82	99.03	99.24

B. Intrinsic Viscosity of Modificated Natural Matrix

Intrinsic viscosity for matlac matrix of secretion of lac insect before modification was 72.93 cP. Table 2 shows intrinsic viscosity data of modified natural matrix of lac insect secretion. Based on the intrinsic viscosity in Table 2. It can be seen that the addition of 5% adipic acid can increase the intrinsic viscosity of the matrix matlac. The increasing of intrinsic viscosity, it will be followed by the increase in molecular weight [25]. So the interaction that occurs between 5% adipic acid and natural matrix of secretion of shellac occur in a straight chain (linear) esters are described as Fig. 2. The intrinsic viscosity of a polymer solution depends on the shape and size of the polymer. For linear polymer molecules, the increasing in the intrinsic viscosity is due to the intermolecular hydrogen bonds of carboxyl group contained in adipic acid so that the addition of 5% adipic acid can produce the maximum intrinsic viscosity.

Table 2. Intrinsic Viscosity of Modificated Matrix from Secretion of Llac Insect

Matrix matlac of secretion of lac insect by adding	**Intrinsic viscosity (cP) at adding *modifier***				
	5%	10%	15%	20%	25%
Adipic acid	77.08	64.90	72.46	29.66	36.26

However, the addition of 20% adipic acid produces a matrix with the lowest intrinsic viscosity. This indicates that the optimum concentration for modification matlac of secretion of lac insect was the addition of adipic acid as much as 5%. The high intrinsic viscosity means matlac matrix with the addition of 5% of adipic acid has the highest molecular weight. The high molecular mass of matlac matrix indicates the molecular chain length. The long-chain molecules that can affect the thermal stability and the transition temperature of the matrix.

Requirements of a polymer matrix can be summarized from several references [26, 27, 28]. First, the matrix must be able to withstand and protect the fiber. Thus the matrix must be able to wrap properly and does not cause excessive internal strain between the fiber and the matrix. Second, the matrix must always be able to keep the fiber in place so it does not disintegrate. Third, the matrix must be able to distribute the load to the fibers. This means that the matrix must have a good bond to the fiber. The increasing chain length of matrix is expected to have thermal properties similar to hemp fiber composed of cellulose threads that have high thermal stability. Furthermore, the increasing length of the molecular chain of matrix can certainly improve the mechanical properties of the resulting biocomposites.

C. Functional Groups of Matrix Matlac

Secretion of lac insect is composed of biobased material is aleuritic acid. This aleuritic acid is polar because it has a carbonyl functional group (C = O) (Mujiyono *et al*., 2010a; Mujiyono, *et al*., 2010d). The electronegativity difference between carbon and oxygen is large enough to make the C = O tends polar [29]. Carboxylic acid functional group (-COOH) at the end of the molecule has a tendency aleuric acidic nature of polar and soluble in water. Long alkyl chains cause the molecules tend nonpolar and only the water-soluble fraction. Therefore, the method of disbursement aleuritic acid with the chemical structure of a matrix matlac can be performed using ethanol solvent. FTIR spectra of matrix without modification and after modification with adipic acid are shown in Fig. 1. Based on FTIR spectra can be seen absorption bands for those materials at specific wave numbers are almost the same. These shows that the functional groups of matrix before and after modification are similar qualitatively.

After modification with 5% adipic acid shows more broad absorption band especially at wave numbers indicating alcoholic functional groups-OH,-CH methylene group, and C=O ester.

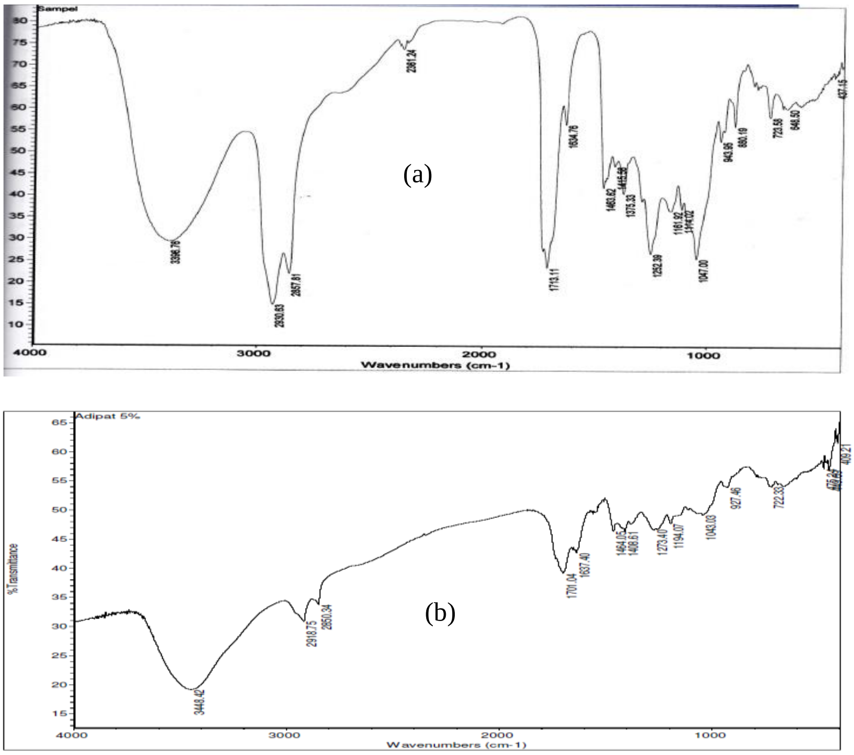


Fig 1. Spectra FTIR Matlac (a). before Modification, (b). after Modification with 5% Adipic Acid

The presence of -OH and C = O to form hydrogen bonds to strengthen the intrinsic viscosity of the data. Interpretation of functional groups for the matrix matlac before and after modification with adipic acid can be seen in Table 3. Absorption bands at certain wave numbers of natural matrix without modification and natural matrix with modification by 5% of adipic acid are almost the same. Thus, the chemical structure of natural matrix without modification and natural matrix after modification is a similar qualitatively. It proves that the natural matrix without modification and after modification show -OH groups, -COO ester, and there are no changes in functional groups. Shellac is consisted of aliphatic hydroxy and esters with carbon chain lengths of 13-15 [30].

Board peak of the spectrum for natural matrix after modification indicates the occurrence of hydrogen bonds between ester, resulting from reaction among aleuritic acid, ethanol, and adipic acid. Less extensive hydrogen bonding, will appear much sharper peak -OH. If the peak appears to be wider, it means -OH bonded hydrogen. The presence of hydrogen bonds may be composed of a polymer chains united straight. The sharper functional groups -OH in the natural matrix without modification indicates that the -OH is not attached hydrogen bonding. Uptake more -OH functional groups widened in the natural matrix with addition of adipic acid 5% indicates a hydrogen bond, so it can be stated that the addition of 5% of adipic acid on a natural matrix causes a reaction between an aleuritic acid with adipic acid to form a linear chain. These results are in accordance with previous research that has been done by Mujiyono in [6], in the study showed an -OH group at a wavelength of 3600-3200 cm^{-1} and CH at a wavelength of 3100-2800 cm^{-1} and the absorption band at 1820 - 1600 cm^{-1} indicate the presence of a carbonyl group C = O ester reinforced with the emergence of C-O ester absorption at wave number 1300 to 1000 cm^{-1}. Figure 2. showed chemical structure for modificated matrix of secretion of lac insect by using adipic acid.

Table 3. Interpretation of Functional Groups for The Matrix Matlac

Wave number of secretion of lac insect	**Wave number of matrix with adding adipic acid 5%**	**Functional Group**
3396,76	3448,42	-OH
2930,63	2918,75	-CH
2857,81	2850,34	
1713,11	1701,04	C=O
1634,76	1637,40	
1463,62	1464,05	$-CH_2$
-	1408,61	
1252,39	1273,40	C-O
1161,92	1194,07	
1114,02	-	
1047,02	1043,03	
~ 900	~ 900	Fingerprint

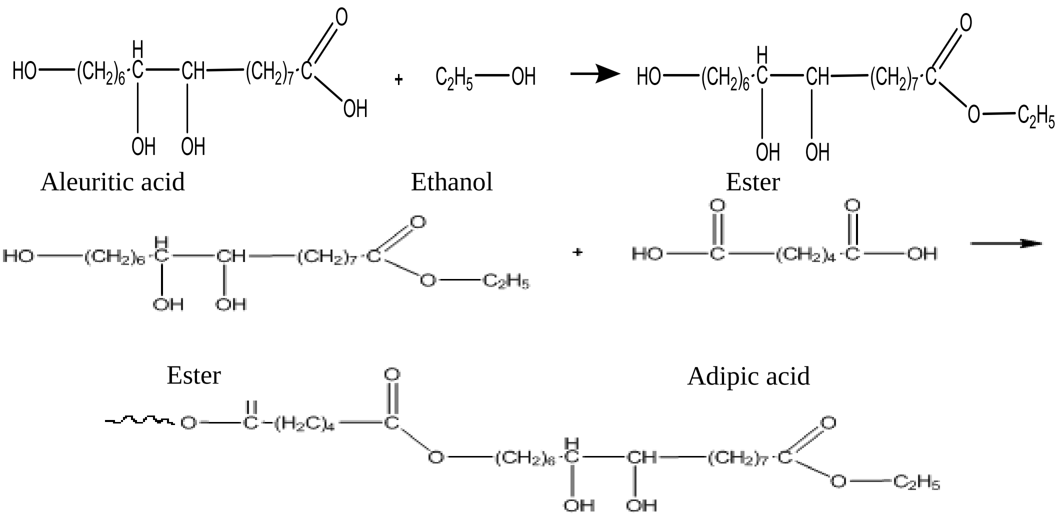
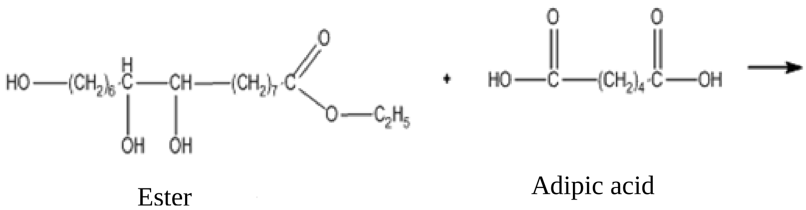
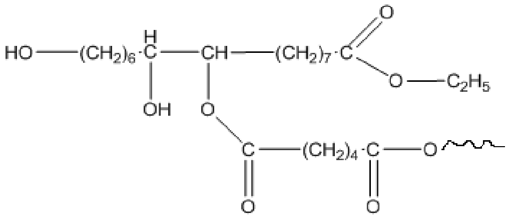


Fig 2. Chemical Structure of Modificated Matrix

Natural matrixs of secretion of lac insect with adding adipic acid 10% , 15% , 20%, and 25% have a viscosity that is lower than the natural matrix of secretion of lac insect without modification. Based on Table 2. indicates that more concentration of adipic acid, value of the intrinsic viscosity decreases. It shows the initial interaction between adipic acid and natural matrix secretion shellac does not occur in a straight chain of ester [30] but in -OH branching (Fig. 3).





or

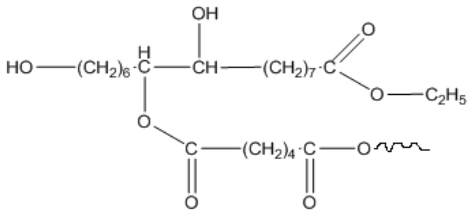
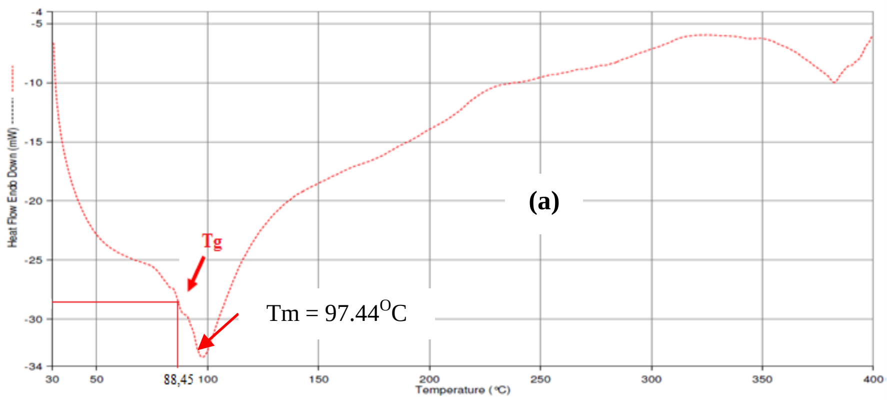


Fig 3. Reaction between Natural Matrix with Adipic Acid in Chain Branching

D. Thermal Properties of Matrix Matlac

The results of the analysis of thermal properties by using DTA-TGA is shown in Figure 4 and 5. Based on Figure 4. showed that the thermogram pattern for matlac from secretion of lac insect without and with the addition of adipic acid has almost the same pattern. In the Figure 4.(b), the glass transition temperature (Tg) of the matrix is not detected, it is possible the glass transition temperature (Tg) occurs after the temperature 400^0C. The glass transition temperature (Tg) in natural matrix by adding adipic acid 5% is higher than the glass transition temperature (Tg) of the matrix natural without modification. This is supported by the value of higher intrinsic viscosity, analysis of functional groups by FTIR which showed absorption -OH functional groups and the melting temperature (Tm) are higher than the natural matrix without modification, so the structure is more rigid.

The change of the melting point of the matrix natural of secretion of lac insect without modification and natural matrix with the addition of adipic acid can be caused by the interaction between adipic acid and secretion of shellac, so it takes a higher temperature to melt the natural matrix of secretion of lac insect with the addition adipic acid.



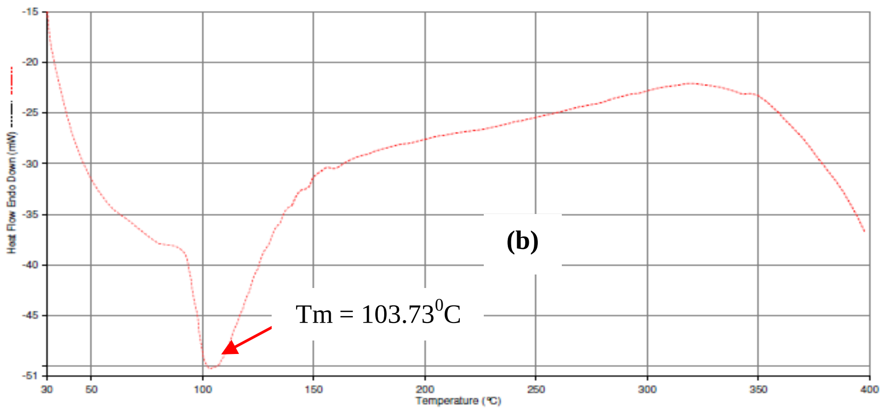
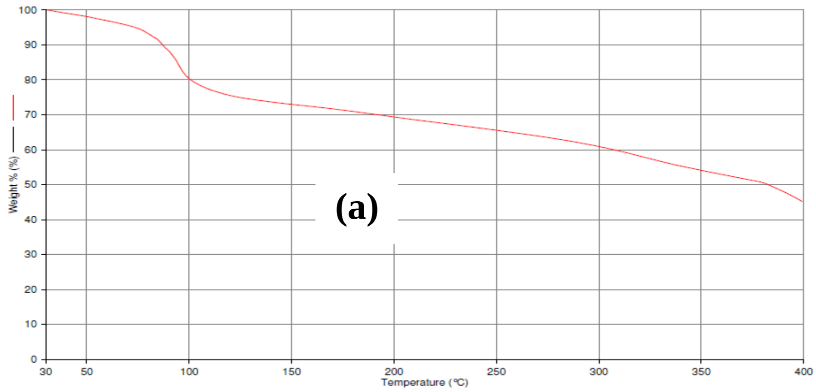


Fig 4. DTA Thermogram for Matrix Matlac (a). without Modification, (b). Addition 5% Adipic Acid

Endothermic peak indicates the melting temperature of the matrix matlac without and with modification. Based on the DTA thermogram in Fig. 3., natural matrix of secretion of shellac without modification has a Tg of 88.45^{0}C. The glass transition temperature is the temperature at which the phase changes occur glassy or rigid (rigid) into a rubbery phase [31]. The existence of a glass transition temperature of the natural matrix without modifications shows that this material has amorphous and crystalline regions [32]. At temperatures 97.44^{0}C shows endothermic peak which is the melting point of the natural matrix. However, natural matrix with addition of 5% adipic acid shows the endothermic peak at a temperature 103.73^{0}C It shows the initial interaction between adipic acid and natural matrix does not occur in a straight chain of ester but in -OH branching (Fig. 3).



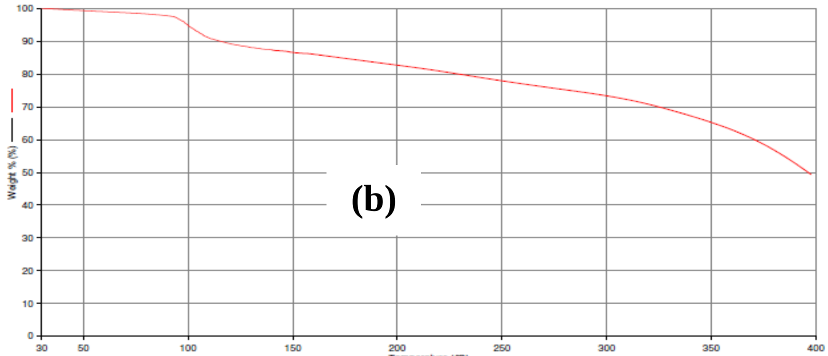


Fig 5. TGA Tthermogram for Matrix Matlac (a). without Mmodification, (b). Addition 5% Adipic Acid

Based on TGA thermogram in Fig. 5 showed that all matrix products from secretion of lac insect without and with modification showed almost the same pattern. Based on the pattern of the thermogram can be stated that increasing of temperature causes the decresing of mass matrix or the increasing of mass loss. Matlac matrix by the addition of 5% adipic acid has the highest thermal stability. The natural matrix without modification and natural matrix with the addition of adipic acid 5 % show the change in mass in

TGA analysis. At each temperature range, the natural matrix with the addition of 5% adipic acid has a more thermal stability. At the initial temperature 50^0C, mass of natural matrix without modification of 98.107% and the mass of the modified natural matrix of 99.556 % . At a temperature of 75^0C - 400^0C sample mass decreases. The mass of the natural matrix without modification at a temperature of 75^0C has decreased to 94.716 % , while the natural matrix with the addition of adipic acid 5% of 98.222 %. At a temperature of 400^0C, sample mass for natural matrix without modification as much as 45.338 % and 49.111 % for natural with the addition of adipic acid 5 %.

Matlac matrix by the addition of 5% adipic acid showed the mass loss below 5% at a temperature of 100^0C, while the other matlac matrix and also the addition of 5% of adipic acid has suffered a loss of mass about 20 % at that temperature. At each temperature range, matlac matrix with the addition of adipic acid shows the mass loss of 2 - 12% lower than the matrix without modification.

E. The Mechanical Properties of Biocomposite

The process of making these biocomposites, using hemp fibers are cut into pieces 2 cm and arranged randomly in the alumunium mold with a ratio of 40% and 60% fiber matrix. According to Daniel Andri Porwanti and Lizda Zohar [33] short fiber composites in the correct orientation will result in greater strength when compared to continuous fiber, in addition to mixing and direction of fiber has several advantages, if the fiber orientation more random, the mechanical properties at 1 direction will be weakened, if the direction of each fiber spread, its power will spread in all directions, the strength will increase. Biocomposites with a ratio of 40% and 60% (matrix : ramie fiber) is the optimum ratio've done on previous research by Mujiyono in [6, 7].

Table 4. shows tensile strength for biocomposites from natural matrix with 5% of adipic acid and ramie fibers. Based on Table 4. tensile strength of biocomposites from natural matrix with 5% of adipic acid are reinforced with ramie fibers is equal to 14.229 MPa. The research that has been done by Mujiyono in [6], the most optimum biocomposites comparison is 40% of natural matrix and 60% of hemp fibers with tensile strength of 87 MPa. That result is much higher than the tensile strength of biocomposites from modified matrix by 5% of adipic acid. This is because the flax fibers used in research Mujiyono [6, 7] been woven, so the mixture between the fiber and matrix more flat and can minimize the cavity between those.

Table 4. Mechanical Properties of Biocomposites

Biocomposite	Stress (MPa)	Strain (%)	Young's Modulus ((MPa)
Average	14.299	1.02%	1391.877

Decrease in stress was also caused by the interaction of the matrix with fiber is weak when given load, causing biocomposites become less potent against a given load. If the interaction between the matrix with fiber a strong, the load imposed on the matrix can occur both on the transfer with fiber to make biocomposites become strong against the load. Besides the fiber is too short causing less strong bonding between the fibers. Long fibers are stronger than short fibers, long fibers can stream or load voltage from the voltage point toward another fiber [33, 34]. It is also found that, modulus of biocomposite from modificated matrix by adipic acid and ramie fiber is high. It can be caused by high crosslink density. The compressive strength and modulus are due to the high crosslink density [35, 36].

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C – 08

PREPARATION AND CHARACTERIZATION OF COBALT OXIDE SUPPORTED TIN OXIDE (CoOx@SnO2) AS PHOTOCATALYSTS

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***Abstract*—** This research was aimed to prepare and to characterize of CoOx@SnO2 which the concentrations of Co 1% and 2,5%.

The compound of SnO2 was resulted by mixing SnCl4 with NH4OH solutions followed by calcinating the obtained solid. The samples were characterized by using FTIR, XRD, UV-Vis Spectroscopy, and SEM/EDX methods. Adsorption test was undertaken in the dark condition by mixing of various concentrations of CoOx@SnO2 onto metyl orange solution.

The XRD analysis showed that the crystal size of CoOx@SnO2 with 1% and 2,5% of Co are 40.4971 nm and 34.7465 nm, respectively. The band gap energy of CoOx@SnO2 with 1% and 2,5% of Co are 1.78 and 1.83 eV. The SEM images presented that the particle size of CoOx@SnO2 are between 0.089 and 0.380 μm. The EDX analysis illustrated that the amount of Co in all samples of CoOx@SnO2 is 0.1%. Adsorption capacity of the samples followed Langmuir isoterm pattern, i.e. 3.274394 and 3.877472 (x10-6) moles/gram for 1% and 2,5% Co, respectively.

Keywords: *Adsorption, CoOx@SnO2, photocatalysts*

I. INTRODUCTION

The development of industries may lead to the environment problems, for example pollution. The liquid waste generated from industrial activities contains hazardous and toxic materials which can interfere water biological processes. Heavy metals and organic waste derived from industries such as the metallurgy, tanning, fungicides, paint and textile industry, may cause water pollutions [1].

Textile waste contains dyes which are generally composed of azo compounds and derivatives in the from of benzene cluster. The benzen is very difficult to degrade naturally. Methyl orange is a synthetic dyestuff widely used in the textile industries. Methyl orange is also used in glass and paint [2]. Azo groups have azo chromophore (-N=N-) binding to the aromatics [3].

Textile waste degradations by using photocatalysts are well known. Using this method, the dye is broken down into simpler components which are environmentally friendly [4-6]. The ability of the UV in degrading organic substance can be optimized by using photocatalysts. Tin dioxide (SnO2) is capable in accelerating oxidation reaction induced by light. The excellence of semiconductor photo catalysts among others the effectiveness in degrading organic pollutants, low prices, the quickness, not toxic and the durability.

However, the use of SnO2 less effective as SnO2 shows the large bandgap (±3,6 eV) [7], which is only suitable in the UV ray condition. The use of SnO2 can be improved, such as by coating the material using CoOx having lower bandgap (Eg) which is better working in the IR rays than UV. A cobalt oxide supported tin dioxide (CoOx@SnO2) material is expected to accelerate oxidation reaction induced by lights.

In this paper, we report the effectiveness of degradation methyl orange by using cobalt oxide supported tin dioxide (CoOx@SnO2) material as photo-catalysts

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II. METHODS

Preparation of SnO_2 and $CoOx@SnO_2$

The compound of SnO_2 is prepared by sol gel methods. One mole of $SnCl_4$ is reacted with 4.1 moles of NH4OH followed by calcinating the obtained solid at the temperature of 900^0C for 4 hours. The photo-catalysts of $CoOx@SnO_2$ is prepared by means of mixing 1.5071 grams of SnO_2 with 0.0291 grams of $Co(NO_3).6H_2O$, into which aquadest is added until the volume has reached 25 mL. The mixture was stirred and dried until almost dry. The solid was then filtered and calcined at 900^0C for 4 hours.

Characterization of the $CoOx@SnO_2$

The compound of $Sn(OH)_4$ in characterized by using the FTIR-Horizon MB300 in the range of 400-4000 cm-1. The compound $CoOx@SnO_2$ is also characterized by using XRD Lab-X Type 6000 Shimadzu Japan, by using the Cu Kα monochromatic radiation with a wavelength (λ) of 1.5406 Å, in the 2θ range of 3 to 90^0.

Morphological, particle size and the element content in the compound are studied by using SEM/EDX JEOL JED-2300 operating at 20 keV. The bandgap energies are studied using UV-Vis 1700 Pharmaspec Spectrophotometer Specular Reflectance Attachment operating at 200-800 nm.

The adsorption ability of the samples were undertaken in the dark by mixing 10 mL methyl orange in a variation concentration (1.5, 2, 3, 4, 6, 8, and 10x10-6 mole/L) with 0.05 grams $CoOx@SnO_2$, and stirred in a shaker for 24 hours. The absorbtions of aliquots were measured, by using spectronic 20 at a maximum wavelengths of (464 nm).

III. RESULT AND DISCUSSION

The reaction between $SnCl_4$ and NH_4OH produces white precipitate of $Sn(OH)_4$. The FTIR spectra of $Sn(OH)_4$ can be seen in Figure 1 .

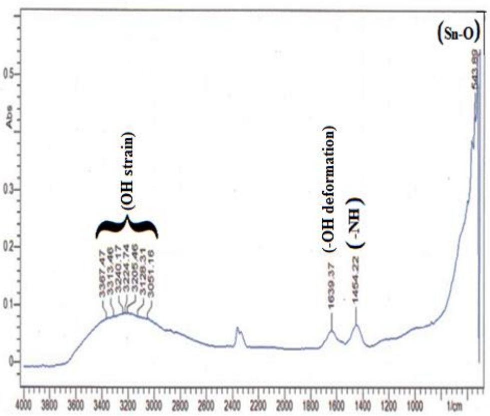

Figure 1. Infrared spectra of $Sn(OH)_4$

Figure 1. exhibits infrared spectra of $Sn(OH)_4$. Spectra in the range of 3700-3000 cm^{-1} indicates OH strain, 1639,37 cm^{-1} –OH deformation of water, and 1454,22 cm^{-1} –NH of ammonia [8]. The infrared spectra also showed the presence of -NH line indicated the existence of NH_4OH trapped in the $Sn(OH)_4$ gel. The sharp line at 543,89 cm^{-1} shows the Sn-O strain in Sn-O-H.

The XRD diffraction pattern of SnO_2 sample can be seen in Figure 2. The SnO_2 and $CoO_x@SnO_2$ samples were analyzed qualitatively by means of comparing the XRD diffraction pattern with those of JCPDS SnO_2 standard.

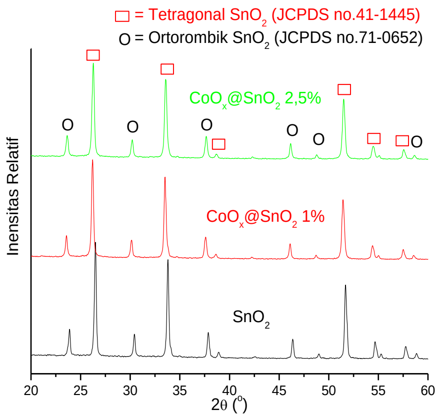

Figure 2. XRD diffraction pattern of SnO_2 and $CoO_x@SnO_2$

Figure 2 shows the existence of strong peaks at 2θ = 26°, 33°, 38°, 51°, 54° and 57° in accordance with the field of crystals (110), (101), (200), (211), (220), and (002) that are characteristic for the tetragonal SnO_2 (JCPDS no.41-1445). Whilst, lines 2θ = 23°, 30°, 37°, 46°, 51°, and 58° in accordance with the field of crystals (110), (111), (021), (022), (130), and (113) is characteristic for the orthorhombic SnO_2 (JCPDS no. 71-0652). These indicate that the samples comprise of two phases namely tetragonal and orthorhombic phases.

The SnO_2 and $CoO_x@SnO_2$ crystallites were studied by applying *Scherrer* equation:

$$D = \frac{0.9\,\lambda}{\beta \cos\theta}$$

The SnO_2 and $CoO_x@SnO_2$ crystallites size is shown in Table 1.

Table 1. The SnO_2 and $CoO_x@SnO_2$ crystallites size

Co (%) in the $CoO_x@SnO_2$	Crystallite size (nm)
0.00	42.0673
1.00	40.0868
2.50	34.7465

The SEM micrograph indicates that SnO_2 and $CoO_x@SnO_2$ has irregular in shape, with sizes as seen in Table 2.

Table 2. Size particle compound SnO_2 and $CoO_x@SnO_2$ 1% and 2,5%

Samples	Particle size (μm)
SnO_2	0.080-1.006
$CoO_x@SnO_2$ 1%	0.091-0.380
$CoO_x@SnO_2$ 2,5%	0.089-0.151

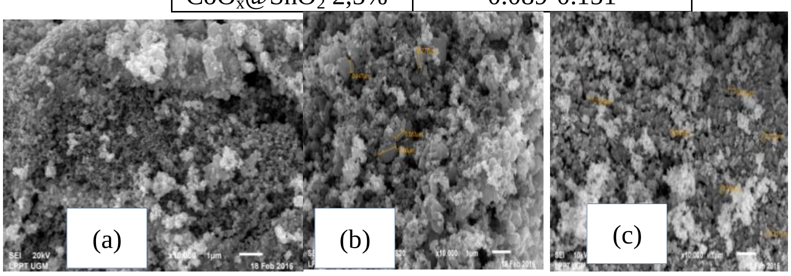

Figure 3. SEM micrographs of SnO_2 (a); $CoO_x@SnO_2$ 1% (b); and $CoO_x@SnO_2$ 2.5% (c)

The characterization of samples by using EDX method may gives information about the percentages of Sn and Co in the compound of SnO_2 and $CoO_x@SnO_2$. The element content of the SnO_2 and $CoO_x@SnO_2$ can be seen in Table 3.

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Table 3. Element content of the SnO_2 and $CoO_x@SnO_2$

Catalyst	Sn (%)	Co (%)
SnO_2	15.86	0
$CoO_x@SnO_2$ 1%	14.43	0.1
$CoO_x@SnO_2$ 2.5%	14.79	0.1

The EDX spectra indicates that impregnation of CoO_x onto SnO_2 was successful. In addition, the maximum amount of CoO_x impregnated onto SnO_2 was ony 1%.

UV-Vis spectrometer was used to collect the reflectance data needed to calculate the bandgap energy (E_g) using *Kubelka-Munk* equation. The bandgap energy of SnO_2 and $CoO_x@SnO_2$ are shown in Table 4.

Table 4. Bandgap energy (E_g) of SnO_2 and $CoO_x@SnO_2$

Samples	Energy gap (eV)
SnO_2	3.01
$CoO_x@SnO_2$ 1%	1.78
$CoO_x@SnO_2$ 2.5%	1.83

The presence of CoO_x could reduce bandgap energy of SnO_2 (Table 4). The adsorption capacity of the samples were studied using Langmuir and Freundlich equations. The Langmuir isotherm adsorption can be calculated using the following equation:

$$\frac{c}{m} = \frac{c}{b} + \frac{1}{K_L b}$$

Where C is the concentration of methyl orange after 24 hours (mol/L) and m is the amount of methyl orange adsorbed by 1 gram sample.

The Freundlich isotherm adsorption can be calculated using the following equation:

$$\log c = \log k + \frac{1}{n}\log m$$

Table 5. Line Langmuir equation of SnO_2 and SnO_2 CoO_x @ 1% and 2.5%

Catalysts	The Langmuir equations
SnO_2	Y = 0.6238x-0.8381 R^2 = 0.9784
$CoO_x@SnO_2$ 1%	Y = 0.3504x-0.4441 R^2 = 0.9827
$CoO_x@SnO_2$ 2.5%	Y = 0.2579x-0.3093 R^2 = 0.98765

The R values of Langmuir isotherm adsorption pattern were higher than the Freundlich. Thus, it can be concluded that the methyl orange adsorption on the SnO_2 and $CoO_x@SnO_2$ 1% and 2.5% catalysts follows the pattern of Langmuir isotherm.

Table 6. Adsorption capacity of SnO_2 and $CoO_x@SnO_2$ 1% and 2.5%

Catalysts	Adsorption capacity ($x10^{-6}$) (mol/g)
SnO_2	1.603078
$CoO_x@SnO_2$ 1%	3.274394
$CoO_x@SnO_2$ 2.5%	3.877472

IV. CONCLUSIONS

Compound SnO_2 can be prepared by using the sol-gel method with $SnCl_4$ and NH_4OH as precursors. The SnO_2 and CoO_x@SnO_2 shows tetragonal and orthorhombic crystal structures. The CoO_x may decreased the bandgap of SnO_2.

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C-09

EFFECT OF EXISTENCE Zn^{2+} AND Cu^{2+} IONS ON EXTRACTION EFFICIENCY OF GOLD(III) USING POLYETHYLENE GLYCOL

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Abstract **-** Extraction of Au(III) from $AuCl_3$ standard solution with two-phase system of an aqueous solution of polyethylene glycol-$(NH_4)_2SO_4$ was performed. The content of gold(III) extracted was determined using UV-Visible spectrophotometer. Two-phase system of aqueous solutions of polyethylene glycol-$(NH_4)_2SO_4$ can extract gold(III) with the extraction efficiency of 95.70 % at pH 2.0. The existence of Zn^{2+} and Cu^{2+} ions could interfere with the extraction process. The efficiency of the extraction of gold(III) fell to 92.60 % in the presence of Zn^{2+} ions, while the presence of Cu^{2+} ions causes the extraction efficiency decreased to 91.30 %.

Keywords: *Extraction, Gold, Two-phase system, Polyethylene glycol*

I. INTRODUCTION

Gold is known as a high-value metals. That is not only because of the beauty and resistance to corrosion, but also ease molded in various shapes and sizes as compared with other metals. Gold is used the manufacture of coins and jewelry. Along with advances in technology, the use of gold expanded to electronics and electrical appliance because it has good conductivity and resistance to corrosion.

Separation of gold from a variety of electronic waste can be performed using a metal extraction. The extraction method is often applied in industry until now in the recovery of metals that have economic value [5,7,8,] Selection of solvent extraction techniques for the advantages it possesses, namely the experimental design in simple, the process is fast and can be done in the macro and micro levels.

Bulgariu and Bulgariu (2011) revealed that the two-phase system polyethylene glycol-$(NH_4)_2SO_4$ in chloride media can be used to separate or extract gold(III) from the solution. Selection of polyethylene glycol as extracting material because it is non-toxic, non-flammable, non-volatile, and environmentally friendly. Environmentally friendly became one of the important points in a chemical research to participate preserve the surrounding environment.

Aside from the solution, gold(III) can also be extracted using a two-phase system polyethylene glycol-$(NH_4)_2SO_4$ of electronic garbage bins. According to Takanori *et al*. (2009), the electronic rubbish bins contain not only gold, but also contain other metals. The metals that may be present in electronic waste include zinc and copper [3]. Therefore, it is necessary to study on the effect of the presence of both these metals to the efficiency of the extraction of gold(III)

II. MATERIALS AND METHODS

A. Materials

The materials used in this study are those materials from Merck that has pure quality analysis, including the polyethylene glycol 1000, $AuCl_3$ standard solution, ammonium sulfate, sodium chloride, sulfuric acid, ammonia, zinc chloride, copper chloride, and aquades.

B. Equipment

The equipment used in this study is pH meter, analytical balance (Ands GR-200), sentrifuge (SORVALL Primo R), and UV-Visible spectrophotometer.

C. Methods

1. Gold extraction using a two-phase system polyethylene glycol-$(NH_4)_2SO_4$

A total of 5.5 mL of 40% ammonium sulfate was added to 1.5 mL of 0.20 M NaCl solution. Depths also added standard solution $AuCl_3$ much as 0.5 mL. The pH value is set in such that it has a pH of 2.0. After reaching the pH is then inserted in 2.5 mL of 40% PEG. The solution system is separated using a centrifuge at room temperature, 7000 rpm for 10 minutes. After centrifugation treatment will be formed with a two-phase solution. Under phase separated and analyzed using UV-Visible.

2. The influence of the presence of Zn^{2+} ions to the gold extraction efficiency

A total of 5.5 mL of 40% ammonium sulfate was added to 0.5 mL and 0.5 mL $AuCl_3$ standard $ZnSO_4$ solution of 0.1 ppm. The acidity of the solution set such that has a pH of 2.0, then put in 2.5 mL of PEG 40% and subjected to centrifugal treatment at room temperature, 7000 rpm for 10 minutes. After centrifugation treatment will be formed with a two-phase solution. Under phase separated and analyzed using UV-Visible.

3. The influence of the presence of Cu^{2+} ions to the gold extraction efficiency

A total of 5.5 mL of 40% ammonium sulfate was added to 0.5 mL and 0.5 mL $AuCl_3$ standard $CuSO_4$ solution of 0.1 ppm. The acidity of the solution set such that has a pH of 2.0, then put in 2.5 mL of PEG 40% and subjected to centrifugal treatment at room temperature, 7000 rpm for 10 minutes. After centrifugation treatment will be formed with a two-phase solution. Under phase separated and analyzed using UV-Visible.

III. RESULTS AND DISCUSSION

A. Gold extraction using a two-phase system PEG-$(NH_4)_2SO_4$

According Bulgariu and Bulgariu (2011), gold(III) can be extracted using a solution of a two phase system using PEG-$(NH_4)_2SO_4$. When a solution of ammonium sulfate salts mixed with a solution of PEG will form two phases, namely PEG phase and salt phase. At first, the metal ions of gold(III) is in phase salt as $AuCl_3$ compound and ion $[AuCl_4]^-$ that will interact with additional chloride ions in interphase. The addition of chloride ions are intended to increase the stability of the ion $[AuCl_4]^-$. The formation of species $[AuCl_4]^-$ occur until the degree of hydration is proportional to the degree of hydration of the PEG phase so that the $[AuCl_4]^-$ ion can be extracted into the PEG phase.

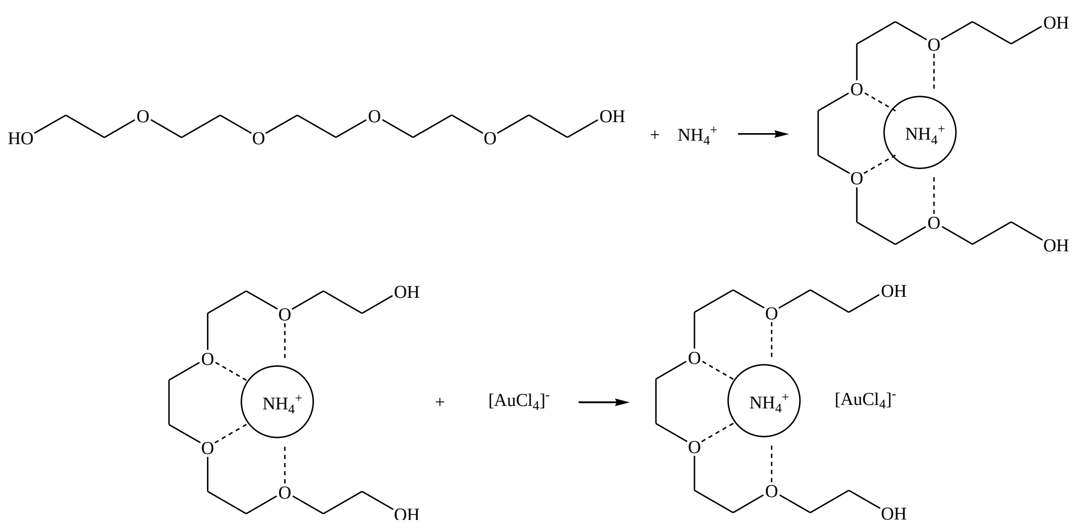

FIGURE 1. SCHEMATIC INTERACTIONS BETWEEN MOLECULES OF PEG WITH A METAL COMPLEX ANION Au(III)

The interaction between the $[AuCl_4]^-$ ion with PEG molecule is possible as shown Figure 1. Ammonium ion that will interact with the positively charged oxygen groups on the PEG molecule. PEG molecules to form interaction with ammonium ions so trapped by PEG molecules to form supramolecular positively charged. The anion $[AuCl_4]^-$ anion will interact with the molecules to PEG that have been bonded with ammonium ion in advance. Supramolecular chemistry focuses on the noncovalent bonding between molecules. Supramolecular chemistry using noncovalent bond is much weaker and reversible, such as hydrogen bonding, metal coordination, hydrophobic style, the style of Van der Waals and electrostatic effect to combine molecules into multi molecules complex

The acidity of the salt solution is an important parameter that can affect the Au(III) ion speciation and the degree of hydration of the PEG phase extraction system [4]. According to Paclawski and Fitzner (2004) at acidic pH (<3.0), gold(III) will be stable as the $[AuCl_3]^-$ ion so that almost all of the gold(III) present in the solution can be attracted and extracted into the PEG phase. Therefore, in this study have a pH of 2.0 in order to obtain the maximum efficiency of gold(III) extraction. This extraction produces large enough extraction efficiency is 95.70%.

B. The influence of the precence of Zn^{2+} and Cu^{2+} ions on the extracton efficiency of gold

The selectivity of the extraction of Au(III) using of a two-phase system PEG-$(NH_4)_2SO_4$ was tested against a bully metals, namely zinc and copper at pH = 2.0. The existence of the two ions can reduce the efficiency of the extraction of gold. Nevertheless, the decline can be said to be not significant, as shown in Figure 2.

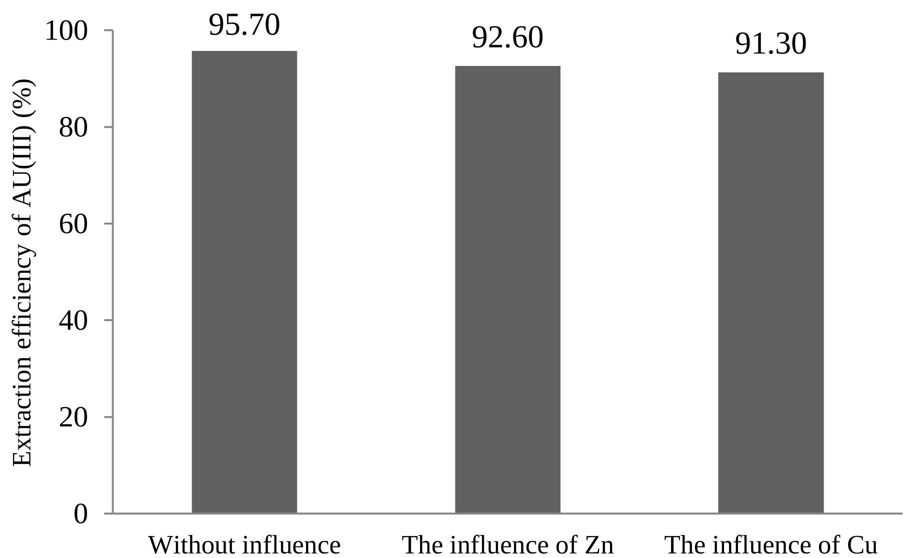

FIGURE 2. THE EFFECT OF THE PRESENCE OF ZN^{2+} AND CU^{2+} IONS TO THE EXTRACTION OF Au(III)

Zn^{2+} and Cu^{2+} ions are a metal that can be extracted using a solution of two-phase systems [1,4]. Extraction scheme which occurs in both the same as the extraction of Au(III). Gold(III), Zn^{2+}, and Cu^{2+} can be extracted maximum at pH < 3.0. Gold(III) will form the species $[AuCl_4]^-$, whereas Zn^{2+} and Cu^{2+} respectively forming species $[ZnCl_4]^{2-}$ and $[CuCl_4]^{2-}$ which has a low degree of hydration and in accordance with the degree of hydration of the PEG phase. Thus, competition between the three possibilities can occur when running the extraction process which caused a decline in the efficiency of Au(III) extracted

The existence of Cu^{2+} ions is more influential than Zn^{2+} ions causes the two different complex stability. The stability of a complex compound is influenced by two factors, namely the influence of the ligand and metal center of the complex. In this study, the ligand does not affect the stability of the complex as it uses the same ligands, namely the chloride anion. Factors of the central metal is affecting the stability of the complex between $[CuCl_4]^{2-}$ and $[ZnCl_4]^{2-}$.

Complex stability generally decreases with increasing radius of the center metal ion. When viewed from the radius of the central metal ion, the Cu^{2+} ion has a smaller radius (r = 0.69 Ǻ) than Zn^{2+} ions (r = 0.74 Ǻ)[2]. Cu^{2+} ion size smaller causing an electronegativity higher than Zn^{2+} ions. The complex is formed from a metal with a high electronegativity will produce more stable complexes. This is because the metal tendency to pull pair of electrons donated by the ligand will be stronger.

The complex stability can also be explained in terms of crystal field stabilization energies factor (CFSE). In the transition metal elements, presence *d* orbital splitting give specific CFSE so as to improve on the complexes formed. Cu^{2+} ions with configuration d^9 have additional energy stability (Δo) was 0.6 both on the state of the high-spin and low-spin. Zn^{2+} ions with d^{10} configuration has the additional energy (Δo) of 0.0. Based on its review, the Cu^{2+} complex will be more stable than Zn^{2+} so that its existence affects the extraction efficiency of Au(III)

IV. CONCLUSIONS

At pH 2.0, gold(III) can be extracted using a two-phase system PEG-$(NH_4)SO_4$ with the extraction efficiency of 95.70 %. The existence of Zn^{2+} ions can reduce the efficiency of extraction becomes 92.60 %. It is equal to Cu^{2+} ions whose presence can decrease the efficiency of 91.30 %. The decline in extraction efficiency is indeed the case, but it can be said to be insignificant.

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C – 10

COMPARATIVE STUDY ON THE IMPACT OF SYNTHESIS ROUTE TO THE PHOTOCATALYTIC ACTIVITY OF ZnO-SiO_2 FROM RICE HUSK ASH

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Abstract — Zinc Oxide based materials are promising materials as photocatalyst instead of titanium dioxide. One of the ZnO form is ZnO-SiO_2 with several advantageous properties for application. In this research synthesis of ZnO-SiO_2 was reported by using rice husk ash as silica source. Effect of surfactant addition to the physicochemical properties and photocatalytic activity of prepared materials is studied. Physicochemical techniques viz. X-ray diffraction (XRD), scanning electrone microscope(SEM) and BET surface analysis were utilized to study the effect of synthetic methodology on the properties of synthesized ZnO-SiO_2. Differences in crystallinity, surface area, particle size by different methods were observed. XRD pattern of ZnO-SiO_2 obtained by sol-gel with cetyl trimethyl ammonium bromide(CTMABr) confirmed larger surface area which also resulted in greater photocatalytic activity in methylene blue degradation.

Keywords: *ZnO-SiO_2; Photocatalyst; Photocatalysis; Rice husk ash*

I. INTRODUCTION

Interest in the functional materials for use in the production and technique for green chemistry has rapidly increased over the years. In the scheme of wastewater treatment and providing clean water for drink and sanitation, such environmental friendly like advance oxidation process and photocatalysis were developed. Furthermore, with an increase in usage and demand for the more efficient systems, development of photocatalyst material due to the potential photoactivity has become a top focus in photocatalysis research[1,2]. To that end, ZnO synthesis, modification and utilization were reported. As reported by previous works, ZnO has a competitive photocatalytic activity (PA) greater in some cases than TiO_2. Therefore in some scheme, the improvement of ZnO photocatalytic activity was attempted by several techniques such as metal dopping and immobilizing in a porous structure materials. The last mentioned technique can be performed by either situ preparation or impregnation into materials like zeolite, clay, MCM-41 *etc*[3,4]. Refer to some papers reporting the photocatalytic activity of supported ZnO in SiO_2 the technique of *in situ* preparation for ZnO attached in a porous structure of silica (ZnO-SiO_2) is reported in this research paper[5,6]. Related to the improvement sustainability, the utilization of the abundance of agricultural waste generated globally, using rice husk ash as silica sources is conceivable. In addition to adding to the sources of silica for usage in green technology and in alternative way for preparation a functional photocatalyst, this process could lead to an avenue for reducing the amount of environmental waste generated from agriculture activities[3][7]. From several reports in the synthesis of ZnO-SiO_2 from synthetic precursors some routes were reported related to the use of surfactant for gaining high specific surface of the material. Some alkyl ammonium based surfactants has been successfully reported to create an ideal structure of ZnO-SiO_2[8]. Since the different route of the synthesis will affect to the physicochemical character of the material, this research provide the comparison on the synthesis over cetyl trimethyl ammonium-bromide(CTMA-Br) molecule as a surfactant template. Study on the structure and surface properties based on x-ray diffraction(XRD), scanning electrone microscope(SEM) and photocatalytic activity for methylene blue(MB) photodegradation is reported.

II. MATERIALS AND METHOD

A.Materials

As material precursor, zinc acetate dihydrate [$Zn(CH_3COO)_2 \cdot 2H_2O$] and isopropanol were supplied from Merck, while CTMABr was purchased from Sigma-Aldrich. Rice husk ash was obtained by ashing rice husk obtained from rural agriculture area in Sardonoharjo district, Sleman, DIY Province at

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700^{o}C for 3h. For photocatalytic activity, MB photodegradation reaction was chosen. Chemical structure of MB is shown in Figure 1.

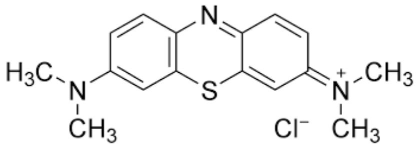

Figure 1. Structure of MB

B. Preparation of ZnO-SiO$_2$

The procedure for preparation of silica gel is refer to the method of TiO_2-SiO_2 synthesis from RHA. Three grams of RHA was diluted into 2 M of NaOH and followed by ageing for 24 h. The solution was filtered and the filtrate was titrated with hydrochloric acid of 1 M until the pH of 8.0 was obtained. The clear solution was aged for 48 h to form gel. Into the gel, zinc acetate dehydrate solution was dispersed at the theoretical Zn:Si mole ratio of 1:4 by predicting Si content of 90 wt%. The mixture was then added with NH_4OH 0.1 M and the stirring was followed until 1 h and homogeneous sol was produced. The solvent was then evaporated by drying in an oven before calcination at 500^{o}C for 4 h. Similar procedure was engaged for the synthesis using CTMA as template but with the CTMA addition before the dispersion of zinc acetate precursor. From these step obtained ZnO-SiO2 was encoded as ZnO-SiO_2(ctma).

C. Analytical Methods

XRD analysis was carried out on a Shimadzu X6000 instrument, scanning electron microscopy (SEM) with elementary dispersive X-ray analysis (EDX) experiments was carried out on an JEOL instrument and surface profile analysis consist of specific surface area, pore volume and pore radius was conducted by NOVA 1200e gas sorption analyzer. XRD was operated at a voltage of 40 kV and a current of 30 mA with Cu Kα radiation.

D. Photocatalytic activity

MB photodegradation was concudted in a batch reactor under UV lamp of 20watt (Figure 2). An UV lamp was set up at 30cm above the mixture of solution-photocatayst powder. During the treatment, sequential sampling was conducted by put treated solution for certain time and then UV-visible absorbance spectra measurement of the sampling solution were measured over a range of 200–800 nm with a Hitachi U 2010 instrument.

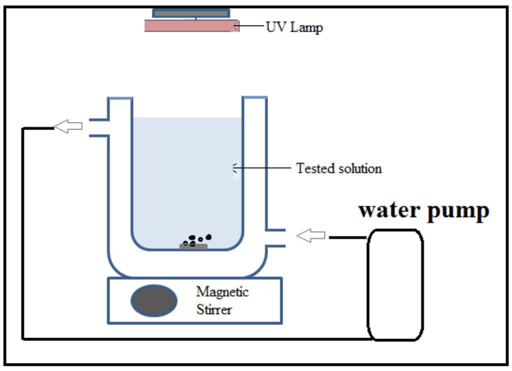

Figure 2: Schematic representation of photocatalytic reactor

III. RESULTS AND DISCUSSION

Figure 3 shows XRD patterns of both prepared ZnO-SiO_2 and ZnO-SiO_2(ctma) materials. The presence of SiO_2 is reflected by broad peaks at around 20° and 68° appeared by both materials while Reflection peaks corresponding to ZnO are (100), (002) and (101) planes are characteristic of the zincite structure(JCPDS file no. 36-1451). By comparing two patterns, it is concluded that ZnO-SiO_2(ctma) give clear pattern related to the presence of ZnO in more crystalline structure than in ZnO-SiO_2. Even there is no perfect pattern of ZnO in the result, it is concluded that CTMA give contribution to give controlled formation of crystalline structure. The similar results were reported by previous works related with the synthesis of TiO2-SiO2, Zn-SiO2 as well as SiO_2 synthesis[9–12,8].

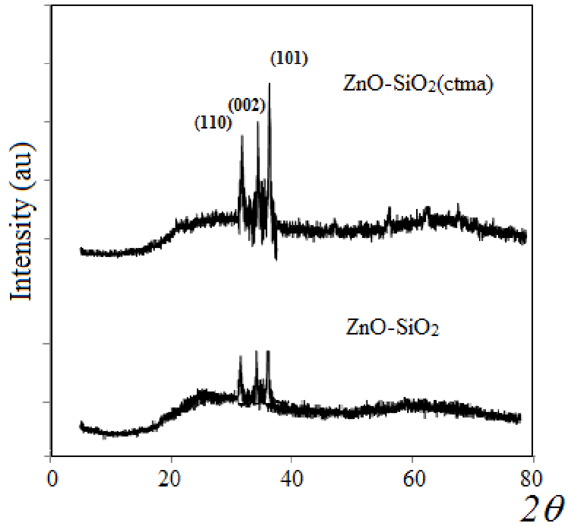

Figure 3: XRD pattern of prepared materials

Effect of CTMA addition is also indicated from surface profile of materials. Figure 4 depicts the N_2 adsorption-desorption profile of both. It is confirmed that ZnO-SiO_2(ctma) produce higher adsorption capacity compared to another one sample. Calculated surface parameters listed in Table 1 is also in line with the pattern in that specific surface area and the pore volume parameters are in the higher values.

Table 1. Calculated surface parameters by gas sorption analysis

Sample/Parameters	**BET Specific Surface area (m^2/g)**	**Pore Volume (cc/g)**	**Pore radius (Å)**
ZnO-SiO_2(ctma)	78.65	0.9876	12.3
ZnO-SiO_2	46.33	0.3211	11.9

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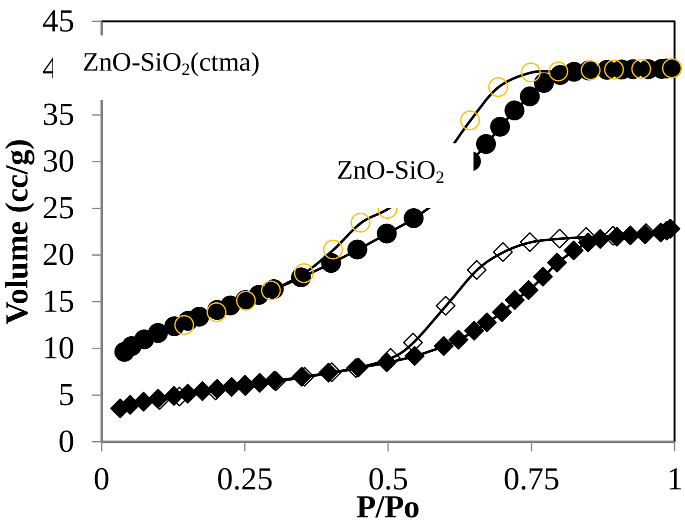
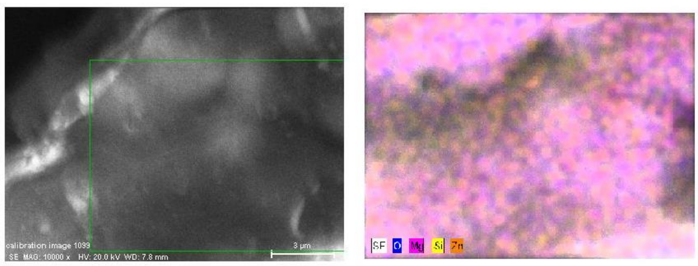
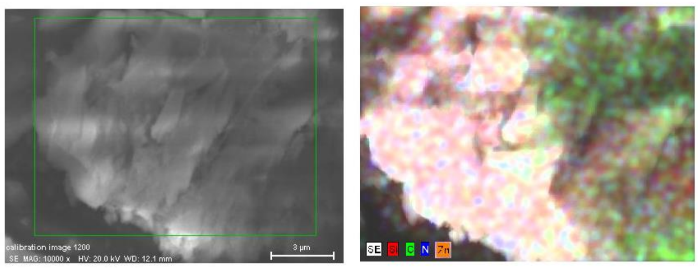


Figure 4. Adsorption-desorption profile of prepared materials

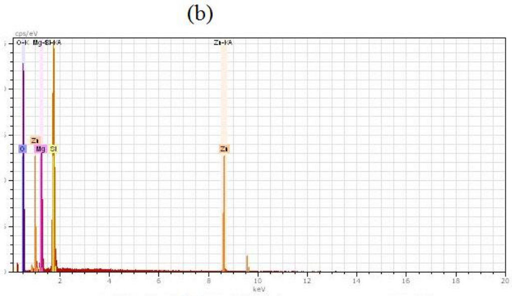
According to the surface parameter data, it is concluded that the sol-gel mechanism involving surfactant action in the synthesis of $ZnO-SiO_2$(ctma) produces the higher order structure. Surfactants constitute a separated section of modifying agents. Surfactants are typically applied in sol-gel techniques to minimize the shrinkage, prevent cracking and avoid supercritical drying processes. The surfactants decrease the capillary stress. CTMA influences by its interaction with pore water and Si–OH groups on the surface of wet gels. In this process, the chloride groups will be substituted by OH groups[12].



(a)



(b)



(c)

Figure 5: (a) SEM profile of ZnO-SiO_2 (b) SEM profile of ZnO-SiO_2(ctma) (c) EDX spectra of SEM profile of ZnO-SiO_2(ctma)

Figure 5 exhibits the difference of surface pofile identified by SEM-EDX analysis. As appeared from the profile, the rougher surface is created for ZnO-SiO_2(ctma) and in addition there are the synthesized ZnO-SiO_2(ctma) as confirmed by detected carbon (C) and nitrogen(N).

Photocatalytic activity (PA) of both material is reflected by the kinetics of MB photodegradation in Figure 6. The PA was measured in two varied process: photocatalysis means the treatment of photocatalyst addition under UV exposure without oxidant addition and photooxidation which is the same condition with photocatalysis but with oxidant (H_2O_2) addition. From the curve it is concluded that for both material, photooxidation serve the higher MB degradation rate compared with photocatalysis treatment. This condition is related with the photooxidation mechanism involving the radicals formation from H_2O_2 cleavage under the presence of radical formed from the interaction between UV and photocatalyst:

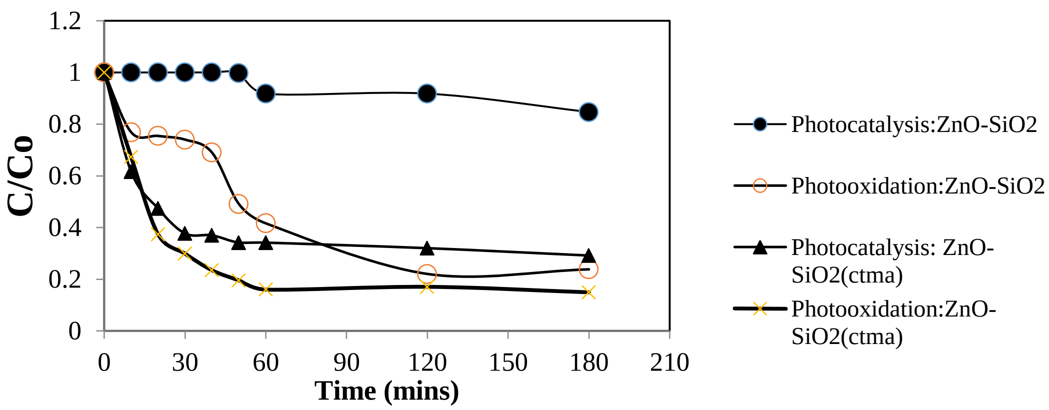


Figure 6: Kinetic curve of photocatalysis and photooxidation over prepared materials.

Electron-hole formation: ZnO-$SiO_2 \longrightarrow e^-_{CB} + h^+_{vb}$
Recombination : $e^-_{CB} + h^+_{vb} \longrightarrow$ heat
Radical formation: O_2(ads) $+ e^-_{CB} \longrightarrow O_2\bullet$
HO• formation: $h^+_{vb} + H_2O \longrightarrow HO\bullet + H^+$
$h^+_{vb} + OH^- \longrightarrow HO\bullet$
$h^+_{vb} + H_2O_2 \longrightarrow HO\bullet$
MB + HO• $\longrightarrow$ degradation products

Radicals are actually formed by the interaction of UV light with photocatalyst semiconductor. Since there is the light interaction, the electron in the valence band (VB) of the semiconductor will be excited into conductance band(CB) and creates hole (h^+_{VB}). Furthermore the recombination occurred, the radical hydroxide will be released into the solution. Since there is the presence of H_2O_2 in the solution, the formed radical peroxides will be accelerated so the degradation rate of MB in photooxidation is higher. By comparing two kinds of materials, it is also found that ZnO-SiO_2(ctma) contributing the increasing rate for both treatments. From the physicochemical parameters it is concluded that the PA is closely related to the characters.

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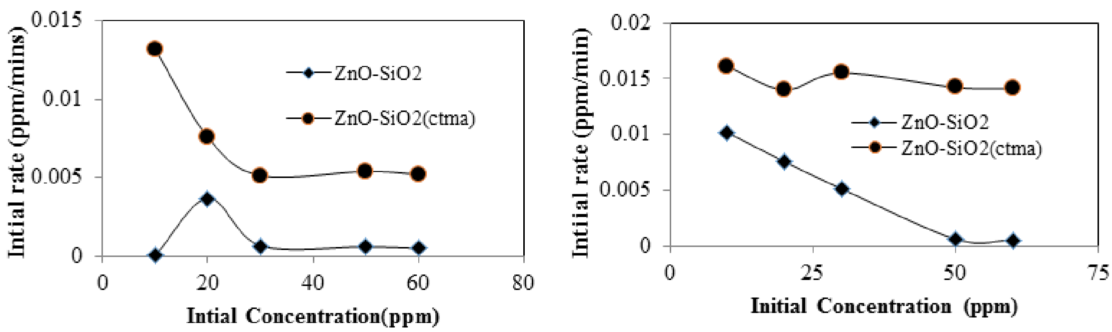

Figure 7: Effect of MB initial concentration on initial rate of MB degradation over prepared materials by (a) photocatalysis (b) photooxidation

IV. CONCLUSION

In conclusion, the synthesis of ZnO-SiO_2 is affected by synthesis route i.e the addition of CTMABr as surfactant and templatein the sol-gel mechanism. It was observed from the XRD analysis that ZnO-SiO_2 prepared by CTMABr addition gives the higher crystalinity. Similar result is found to surface parameters of specific surface area and pore volume parameters. Improved parameters plays important role in the photocatalysis and photooxidation of methylene blue.

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C – 11

An Investigation of Insect Ovipositing Repellent Activity of *Andrographis paniculata Ness* Leaf Extracts to Batrocera carambolae

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Abstract. *Batrocera carambolae* was one of the major pests on several kinds of fruits, especially on starfruit. This pest attacks resulted damage quantitatively, with the fall of the young fruit and qualitatively, the fruit becomes rotten and containing maggots. This study was done to determine whether selected *Andrographis paniculata Ness* leaf extracts were repellent activity to *Batrocera carambolae*. Initially, three extracts from maceration process were evaluated by putting extracts and flies together in the cage. Ethanol, ethyl acetate, and n-hexane *Andrographis paniculata Ness* leaf extracts were applied to fruits and the fruits were put into a cage containing male and female flies. From observation, n-hexane was the best extract and has the potency to be used as a tool to protect starfruit from *Batrocera carambolae* oviposition.

Keywords: *Batrocera carambolae, Andrographis paniculata Ness, maceration, n-hexane, ovipositing, repellent, starfruit*

I. INTRODUCTION

Pest problems is one of the obstacles in order to increase crop production both in quality and quantity. Fruit flies is one of the major pests on several kinds of vegetables and fruits. They are very detrimental to agriculture. This pest has spread to almost all the Asia-Pacific region [1]. Fruit flies cause damage quantitatively, with the fall of the young fruits are attacked and qualitatively, the fruit becomes rotten and containing maggots [2,3].

The use of synthetic insecticides for pest problems is not an appropriate answer, because in the application of sprays often miss the mark (flies fly), also not environmentally friendly and often leave pesticide residues on commodities that are protected [2]. In addition, eco-labeling was a requirement for a product to be accepted the world market so the using of synthetic insecticides should be reduced as low as possible. Therefore, research on natural insecticides were developed.

The test results by using attractant methyl eugenol dripped on cotton in the trap of giving good results as the male fruit fly attractant. The attractant only attract male fruit flies, because it is paraferomon. Meanwhile, the cause of damage to the fruit is female fruit flies that lay eggs in fruit by piercing or injuring the surface of the fruit with their ovipositor [4].

Reference [5] using the essential oils of basil leaves (*Ocimum gratissimum* and *Ocimum bassilicum*) diluted with liquid paraffin as a repellent against mosquito Aedes aegypti. Reference [6] did a test the ethanol extract of the leaves and tubers of *Mirabilis Jalapa* as repellent (insect repellent) to prevent oviposition imago *Crocidolomia binotalis* on cabbage (*Brassica oleracea*).

Secondary metabolites or essential oils of some plants can be used as a repellent against insect pests or specific. It is then explored more deeply by [7] who found that the essential oil of citronella and dried basil have Insect Ovipositing Repellent activity. In 2011, [8] explore the tobacco leaf extracts and basil as Insect Ovipositing Repellent of *Batrocera carambolae* which indicated that the compound of the terpene class of the leaf gives a positive result fruit flies repellent.

Andrographis paniculata Ness is a plant that has a distinctive odor and suspected of containing compounds essential oils. The leaves of these plants has been widely reported to be useful as a natural pesticide. Reference [9] reported that the water extract of bitter leaf potential as larviciding and very effective for controlling *S. litura* (armyworm).

Based on the facts and previous research, an investigation of *Andrographis paniculata Ness* extract as a natural pesticide is still interesting to do, especially as Insect Ovipositing Repellent of *Batrocera carambolae*. In addition, it is expected that the product can be used by Indonesian farmers in synergism with government programs to promote the export of agricultural products, especially horticultural Indonesia.

II. EXPERIMENTAL DETAIL

All chemicals used were of analytical grade from Merck and Co. Inc. include n-hexane, ethyl acetic, ethanol. The main material of this research is *Andrographis paniculata Ness's* leaf from traditional market in Yogyakarta. The tester fruit flies and other supporting materials have been provided by from Department of Pests and Plant Diseases, Gadjah Mada University. The instrument used in this study include artificial enclosure and a set of glassware.

The investigation of Insect Ovipositing Repellent was carried out by rubbing extract of n-hexane, ethyl acetate and ethanol *Andrographis paniculata Ness* on starfruit which is then tested in fruit flies that had been prepared in a cage. First, Andrographis paniculata Ness's leaf was dried. A total of 200 g dry sample subsequently blended up into powder. The powder was stored in plastic bottles for use in the next research steps. The powder sample was extracted successively with n-hexane, ethyl acetate, ethanol by maceration method to extract the sample components. The extract obtained by the evaporator. The extracts are referred to as hexane extract, ethyl acetic extract and ethanol extract thus obtained 3 types of extracts. All the extract is applied to the star fruit and placed in a cage occupied 10 fly male and 10 female flies and control samples (starfruit are not oiled). The sample was observed from 3-6 days later and continued with the process of observation and calculation of larvae present in the star fruit.

III. RESULTS AND DISCUSSION

In the extraction process of *Andrographis paniculata Ness*'s leaf powder, maceration method is used. This method is chosen because does not use heat in the process. The use of heat in the isolation process could damage secondary metabolites in plants. This is done until the solvent extraction becomes translucent color. This shows that there is no more metabolites that can be fastened by solvent. Maceration process is done gradually, starting from the use of n-hexane which is a non-polar solvent, followed by ethyl acetate which is a semi-polar solvent and ends with ethanol is a polar solvent. Hence it will be obtained fraction of compounds that are non polar, semi-polar and polar from *Andrographis paniculata Ness*'s leaf.

Maceration extract is evaporated to remove the solvent and the product is obtained in the form of greenish-black liquid with a weight of 17.8 g (8.9%). N-hexane is the non-polar solvent that can damage the leaf tissue to be opened and secondary metabolites in leaves can be extracted. N-hexane can extract some of chemicals such as wax, lipids and volatile oils. Using n-hexane will isolate the non-polar compound while the classes of compounds that are polar and semi-polar is still contained in the powder. Furthermore, the fraction of n-hexane is stored in a desiccator until the t is ime of testing as a fruit fly repellent. After first maceration using n-hexane, the leaf powder is dried in room temperature for next maceration process.

The second maceration is using ethyl acetic as solvent to extract semi polar compound from *Andrographis paniculata Ness*'s leaf powder. Ethyl acetate is a good solvent for extraction because it can be easily to evaporated and have low toxicity. Extracts obtained yellowish green then evaporated using a vacuum rotary evaporator to obtain a thick extract. Viscous extract obtained as 9.8 g (4.9%). Therefore, the compounds remaining in the *Andrographis paniculata Ness*'s leaf powder is polar compounds.

To extract the remaining polar compounds, ethanol is used as a solvent. The reason for choosing ethanol because it is safer to use than other alcohol compound and can accommodate polar compounds with long carbon chains. Brownish green extracts then evaporated using a vacuum rotary evaporator to obtain a thick extract. The product have specific weight, that is 35.9 g (17.45%). After this step, Andrographis paniculata Ness's leaf powder is disposed to trash.

All of *Andrographis paniculata Ness*'s leaf extracts are tested under laboratory conditions for ovipositing repellent activity. As many as 10 male and 10 female of *Batrocera carambolae* that are ready to breed, placed into a testing cage. In the testing cage also placed starfruit as test sample because this fruit is a favorite host for *Batrocera carambolae.* Three prepared cages containing five components (feed, star fruit unsmeared by any extract (control), star fruit which is smeared n-hexane extract, star fruit which is smeared ethyl acetic extract and star fruit which is smeared ethanol extract) used for repellent test. Observations were made by observing the behavior of *Batrocera carambolae* for 4 days. These observations were made to determine the tendency of fruit flies to perch and lay their eggs on the sample. Observational data presented in Table 1.

TABEL 1. THE FREQUENCY OF FRUIT FLIES PERCH FOR 4 DAYS

Sample	Solvent	BOX		
		A (Amount of Flies)	B (Amount of Flies)	C (Amount of Flies)
Andrographis paniculata Ness	Ethanol	3	1	1
	n-hexane	-	-	-
	Ethyl asetic	4	4	3
	Control	15	8	6

In general, *Batrocera carambolae* in the cage gather around feed and control. Only occasionally fly to smeared starfruit. However, the possibility of laying process can occur. From three extracts, only the n-hexane extract that is not plagued by *Batrocera carambolae*. However, ethanol and ehyl acetic extracts less plagued than control. Therefore, the laying process may not occur in smeared samples using n-hexane.

After 4 days, the flies transferred to another cage and on day 7 samples of starfruit dissected to count the number of larvae from *Batrocera carambolae.* The number of larvae contained in fruits can be correlated with the number of eggs injected by female flies. Counting larvae must be done carefully without skipping any larvae that live in the flesh of star fruit. The calculation is performed on day 7 because onthat time the size of larva is large enough so it is easy to observe. Observational data presented in Table 2.

TABEL 2. THE FREQUENCY OF LARVAE

Sample	Solvent	BOX		
		A (Amount of larvae)	B (Amount of larvae)	C (Amount of larvae)
Andrographis paniculata Ness	Ethanol	4	18	12
	n-hexane	-	-	-
	Ethyl acetic	34	48	58
	Control	145	45	71

From Table 2, it was found that n-hexane extract had a good performance as the ovipositing repellent. However for ethanol and ethyl acetate extracts can not impede the fruit fly to lay eggs in starfruit. It can be seen from the number of larvae present in the flesh of the fruit. Nevertheles, both the extract (ethanol and ethyl acetic) had little inhibitory effect on fruit flies. It can be seen from the small number of larvae found in fruit which are coated with both the extract. The amount of larvae on ethanol and ethyl acetic extracts smaller than amoun of larvae on control.

IV. CONCLUSION

N-hexane extract from *Andrographis paniculata Ness*'s leaf is the best extract and has the potency to be used as a tool to protect starfruit from *Batrocera carambolae* oviposition. While ethanol and ethyl acetic extracts from *Andrographis paniculata Ness*'s leaf have small inhibitory effect on *Batrocera carambolae.*

ACKNOWLEDGMENT

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C-12

Isolation of Prenylated Flavone from the Bark of *Artocarpus Elasticus* Alor Island – East Nusa Tenggara

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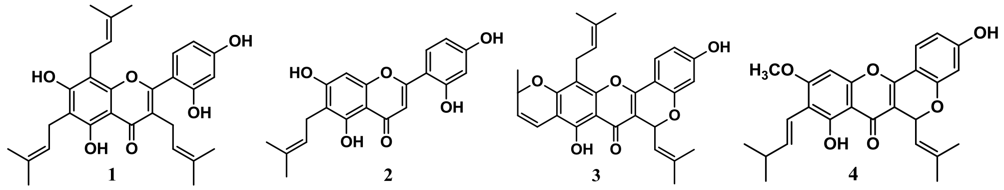
Abstract. Artonin E, is a prenylated flavoned in the form of a yellow solid with a melting point 143-145 C,. It has been isolated from the bark of Artocarpus Elasticus, which is an endemic plant from Alor Island – East Nusa Tenggara with local name Tongtong that has potential as a flavonoids source. The separation process resulted from the ethyl acetate extraction was fractionated by vacuum liquid chromatography with methylene chloride, ethyl acetate, and methanol based on increasing polarity. Purification was done by recrystallization using a solvent mixture of heated methylene chloride and n-hexane. The structure of compound was determined by UV, IR and NMR spectroscopy.

***Keywords**: Flavonoid compounds , Artocarpus , Artocarpus elasticus , artonin*

I. INTRODUCTION

Artocarpus is an important genus of Moraceae family, consists of about 50 species spreaded across Sri Lanka, India, Pakistan and China, but the greatest diversity is found in Indonesia (Venkataraman, 1972). Tongtong is part of Artocarpus genus. It is a big plant that can grow up to 30 m high. The Latin name of this plant is Artocarpus elasticus. In Indonesia this plant is known by other names among which Mengko (Aceh), Torop, Hatapul miak (Batak), Benda, Teurap (Sunda), Benda B, Ketan B, Kebo (Java), Kokap (Madura), and Terap (Sumatra) (Heyne K., 1987). While on the island of Alor - East Nusa Tenggara, *Artocarpus elasticus* is known as Tongtong. Tongtong is a plant that is potential source of flavonoids. Tongtong is often used by local people of Alor island. Its trunk is used as bulding material, while the leather sap is used as glue and the leaves are used as mosquito repellant.

Some previous researches have been reported the isolation of several prenylated flavone derivatives from *Artocarpus elasticus*, such as artelasticin (**1**), artocarpesin (**2**), artelastochromene (**3**) (Kijjoa *et al*., 1996), and cycloartocarpin (4) (Mustapa *et al*,. 2009).



1 2 3 4

Chemotaxonomic approach suggests that the geographical differences often produces different isolated compounds. Therefore, it is encouraging to isolate flavone derivative compounds from the bark of Artocarpus elasticus from Alor Island-East Nusa Tenggara.

II. METHODS

A. Materials

Plant materials: the bark of *Artocarpus elasticus* from the Alor island –Nusa Tenggara Timur. A specimen was identified in LIPI Purwodadi.

Instruments and Chemicals. Melting points were determined on Fisher John-melting point Apparatus. UV-Vis Spectrophotometer. IR spectra were measured with FT-IR PRESTIGE 21 (SHIMADZU) spectrophotometers. ^{1}H and ^{13}C-NMR spectra were recorded with JEOL-Nuclear Magnetic Resonance spectrometer JEOL ECA 500 operates at 500 MHz. VLC was carried out using Merck Si gel 60 GF254 and TLC analysis on precoated Si gel plates (Merck Kieselgel 60 F254, 0.25 mm).: Silica gel Merck Si gel 60 GF254 is used for column chromatography, while Merck Kieselgel 60 F254 0.25 mm is used for TLC.

B. Procedures of Extraction and Isolation

Dry powder of *A Elasticus* bark (5kg) is macerated in ethylacetate. The ethyl acetate extract (30 g) was fractionated by column chromatography using methylene chloride (CH_2Cl_2), ethyl acetate (EtOAc), and MeOH based on increasing polarity to give 6 fractions. There are 3 fractions (B, C and D) which have relatively the same R_f value, so that the combined and further fractionated by VLC method using MeOH: methylene chloride based on increasing polarity. Results from the second fractionation combined fractions obtained 6 (A-F) are monitored by TLC. At D fraction of precipitation, then filtered using vacuum filtration, purified by recrystallization methylene chloride and *n*-hexane and D as compound **1** (260 mg) were obtained.

III. RESULTS AND DISCUSSION

Compound 1 was obtained as yellow solid with melting point of 143-145 ° C. UV spectrum shows absorption at λ_{maks} 252 nm and 356 nm. Addition of sodium hydroxide causes the tape I experienced a bathochromic shift (10 nm) from 356 nm to 366 nm which showed the presence of free hydroxyl groups. But did not experience a shift when the addition of sodium acetate. On the addition of aluminum chloride lead to tape I experienced a bathochromic shift from 356 nm to 420 nm. IR absorption bands were observed at 3431 cm -1 and 3381 cm-1 which is the characteristic of O-H absorption. Absorption at 2980 cm-1, 2856 cm-1, 2762 cm-1 is typical for CH aliphatic, absorption at 1654 cm-1 showed a carbonyl group while the absorption 1481 cm-1, 1560 cm-1 and 1604 cm-1 show their aromatic CH.

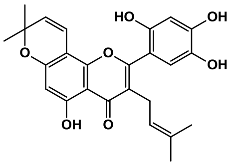
^{1}H-NMR of compound 1 (Table 1) showed two singlets at δ 6.45 and δ 6.68 which is an aromatic proton pair to ring B. Compound 1 also shows the typical signal -signal for 2,2-dimethilkromen ring at δ 1.41 (2 x 3H), δ 5.70 (1H, d, J = 10.0 Hz), δ 6.50 (1H, d), signal - proton signal for dimethylallyl group at δ 1.40 and δ 1.55 (each 3H), δ 3.02 (2H, d, J = 6.7 Hz) and δ 5.04 (1H, t) , Compound 1 also shows the signal at δ 6,20 (1H, s) according to proton aromatic to ring A -containing kromen. These data suggested that compound 1 is a prenylated flavones. Based on data from ^{1}H-NMR, compound 1 has the same chemical shift of Artonin E (Jayasinghe, *et al*., 2008).

The data reinforced with ^{13}C-NMR spectral data. Where in showed the carbon carbonyl at δ 181.8, one oksikarbon at δ 78.0, six carbon metin at δ 127.6, δ 121.4, δ 119.8, δ 114.1, δ 104.2 and δ 100.4, a carbon methylene at δ 23.6, and four carbon methyl at δ 27.6 (2C), δ 25.4 and δ 17.3.

Table 1. Data Comparation of ^{1}H-NMR and ^{13}C-NMR Compound 1 with Artonin E in DMSO

Position	**Compound 1**		**Artonin E**	
	δH (ppm)	**δC (ppm)**	**δH (ppm)**	**δC (ppm)**
2		161,6		163,2
3		121,4		122,0
4		181,8		183,9
4a		104,2		105,9
5		160,9		162,7
6	6,20 (1H, s)	98,7	6.14 (1H, s)	100,1
7		158,4		160,5
8		103,8		102,2
8a		151,7		153,8
9	3,02 (2H, J=6,7)	25,4	3.11 (2H, J=7.0Hz)	24,9
10	5,04 (1H, t)	109,2	5.10 (1H, m)	122,6
11		131,3		133,3
12	1,55 (3H, s)	23,6	1.59 (3H)	25,9
13	1,41 (3H, d)	17,3	1,41 (3H, brs)	17,6
14	6,50 (1H,d,J=10,0)	114,1	6.61 (1H,d,J10.0Hz)	115,8
15	5,70 (1H, d,J=10,0)	127,6	5.59 (1H, d, J 10.0Hz)	128,2
16		78,0		79,1
17	1,40 (6H, d)	27,6	1,43 (6H, s)	28,4
18		27,6	1,43 (6H, s)	28,4
1’		116,0		111,7
2’		148,4		150,1
3’	6,45 (1H, s)	100,4	6.45 (1H, s)	104,7
4’		148,7		150,0
5’		138,0		139,4
6’	6,68 (1H, s)	119,8	6,69 (1H, s)	117,2

Data of ^{1}H NMR and ^{13}C NMR spectra were obtained 1 compound has similarities with compounds data of Artonin E from the root bark of Artocarpus Nobilis (Jayasinghe, et al., 2008).



Artonin E

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IV. CONCLUSION

Artonin E compounds have been isolated from the bark of Artocapus elasticus which is a prenylated flavones at C-3, oxygenated at the 2 ', 4', 5 ', 5 and 7 and containing 2,2-dikromen ring on C-8.

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C-13

Removal Characteristics of Silver with Electrokinetic by Adsorption on Soil Mineral from Kotagede Yogyakarta

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Abstract—The adsorption characteristics of Ag (I) on four different soil of Kotagede Yogyakarta, Indonesia were examined to investigate the geochemical behavior of Ag (I) in contaminated sites. The removal of Ag (I) from mineral soil was enhanced by hydro chlorite and nitrate acid using electrokinetic remediation at 7 d process in constant voltage of 20 V. The results from batch experiment showed that the acid has more sufficient to remove Ag (I) from mineral soil compared than that distilled water as a purging solution in the electrokinetic remediation, particularly the hydrochloride acid as well. The pH and CEC of soil mineral might be important physicochemical factors that could remarkably affect on the removal of Ag (I) from soil. The surface area of soil has no significant effect on the adsorption of Ag (I) to soil.

Keywords: *Adsorption, Ag (I), acid solution, electrokinetic, Kotagede*

I. INTRODUCTION

Concern about trace metals in natural water and soils has generated in sources, mode of aqueous transport; retention times in the water column and sediment burial rates. Adsorption and ion-exchange is one of the fundamental and significant process that control the mobility of metals in the soil environment, helps in predicting the migration of these metals in the geological formation [1] and for evaluating the feasibility of a particular material for the disposal/recovery [2].

Average concentration of silver (Ag) in soil is < 0.5 μg/g [3], while the concentration limit in the fresh water is 0.2 μg/L and sea water is 0.25 μg/L. Based on the Indonesian Government Regulation No. 85/1999 on the quality standard of TCLP for pollutants in wastewater, silver concentration limit is 5.0 mg/L. Therefore, low silver concentration should be present in the environment. The behavior of Ag in soils is strongly influenced by the prevailing pH and redox conditions, and by interactions with soil organic matter. In field soils, Ag tends to accumulate in the surface, organic-rich horizons [4]. Earlier studies indicated that, once accumulated in the soil surface layers, Ag was persistent and leaching was slow [5]. Leaching experiments with 110mAg and stable Ag salts indicated that Ag was highly immobile in soils relative to silver plating is extensively used by various industries for production of durable and decorative products. The metal is normally plated from alkaline cyanide solutions that usually generate silver dicyanide [$Ag(CN)_2^-$] as a contaminant in the wastewater [7]. Silver dicyanide may be accompanied by other silver species and is a chemically stable and extremely toxic metal complex of high mobility in the environment. Kotagede is a special region in Yogyakarta province whose silver handicraft is produced for souvenir. A similar product is also produced in Koto Gadang (West Sumatera), Bangil (East Java) and Celuk (Bali). In 2012, total export of these products is US$ 76.12 million [8]. Consequently, the volume of waste stream into the environment increased with the increase silver handicraft production in those areas. At present, there are some methods exist for silver removal from aqueous solution using precipitator reagents, e.g $FeCl_2$, $Ca(OH)_2$ and NaOH [9], clay absorbent [10], concrete particle [11] and phytoremediation [12]. However, for silver contaminated soil, there is no effective method to remediate the soil other than dig and dump system as it is a commonly used for soil remediation.

Previous study have demonstrated that the electrokinetic (EK) remediation had been used on the removal of heavy metal from electroplating contaminated soil in laboratory scale [13] and field soil [14]. Importantly, so far the EK remediation process had not been tried to remove silver from Kotagede contaminated soil. In this study investigates the enhanced removal of Ag from soil by EK process through varying the acid flushing solution. Artificially silver contaminated soil was prepared as a model of soil in this EK process. Laboratory scale horizontal soil column studies were done using nitrate or chloride acids as a flushing solution in EK for a time period of only 7 d, allowing for a comparison of Ag removal efficiency. The physicochemical of Kotagede soil is also evaluated.

II. MATERIAL AND METHODS

A. Collection and characterization of soils

Soil properties are summarized in Table 1 and collected from four different locations at Kotagede district in Yogyakarta city, Indonesia. Soil sampling (30.0 cm diameter and 30.0 cm depths) was carried out at the locations shown in Fig. 1 and exact position was indicated by using GPS points (see Fig. 2). The soil data samples from uncultivated lands, such as shrubs and house yard were selected as sampling sites included soil sample near silver handicraft workshop (locs. A and D). The soils were dried in the open air for a period of one month and sieved through 4 mm before use to remove stones and large debris. Homogeneous material was obtained by passing the soils through a 200 µm screen. Soils were artificially amended with 100 mg/kg silver concentration (i.e. $AgNO_3$ salts) and then treated with six cycles of saturation process using de-ionized water and air-dried before being aged for one year. The pH was measured in 1:20 (mass/volume) water suspensions, after equilibration period for 4 hours using a pH meter (Mettler-Toledo FE 20, Switzerland) as described in the paper [15]. The buffer capacity was determined for each soil sample by the acid-base titration method as described in Vazquez et al. [16]. For total metal analysis, about 1.0 g of dry soil sample was digested overnight with 10 mL of HNO_3 and then the supernatant was then measured for total concentration of Ag by Flame-AAS (Buck Scientific 205, USA). An emphasis in the characterization of soil was on the measurement of the specific surface area (SSA), a key parameter that strongly influences the sorption capacity of solid surfaces [17]. The SSA was measured by nitrogen adsorption (SSA-N_2 at 77 K) methods using a Bel Sorp mini (Bel, Japan). The SSA-N_2 was calculated using the Brunauer-Emmet-Teller (BET) equation.

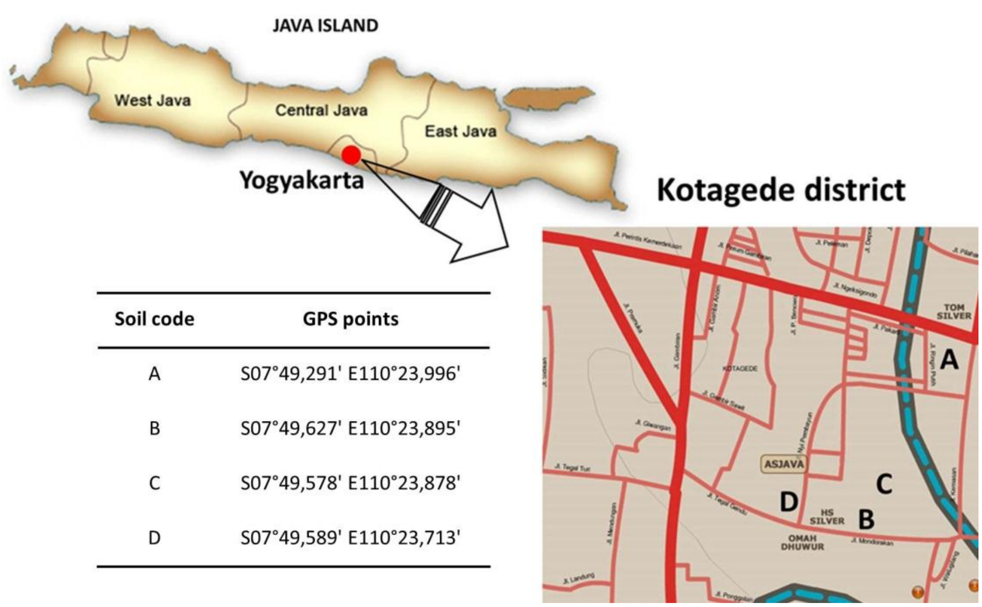

FIGURE 1. SAMPLING POINTS OF SOIL AT KOTAGEDE DISTRICT OF YOGYAKARTA PROVINCE, INDONESIA

B. Elekctrokinetic experiments

A series of bench-scale EK experiments were conducted using a clear acrylic box oriented horizontally as shown in Fig. 2. The testing box consists of three major parts, a soil chamber and two electrode compartments. The soil chamber (150 mm x 20 mm x 35 mm) was containing soil specimen where connected to the electrode compartments in both ends. Graphite and stainless SS 316 electrodes were used for the cathode and anode, respectively. In this study, 0.1 M HCl or HNO_3 was used throughout the experimental works as a purging solution since strong acid has been determined to be adequate with the aim of removal silver ion from soil. A 20.0 V/cm of potential gradient was applied for 7 d experimental and the electric currents were monitored during the test periods by using midi logger (GL200A, Graphtec USA). The soil sample was sectioned into five parts after the completion of each test, and the silver ion was extracted from soil by acid digestion (e.g. 1 g soil was mixed with 50 mL of 1.0 M HNO_3 and then shaking for 24 h). The concentration of silver ion in the supernatant was determined by flame-atomic absorption spectrophotometry at λ 328.1 nm.

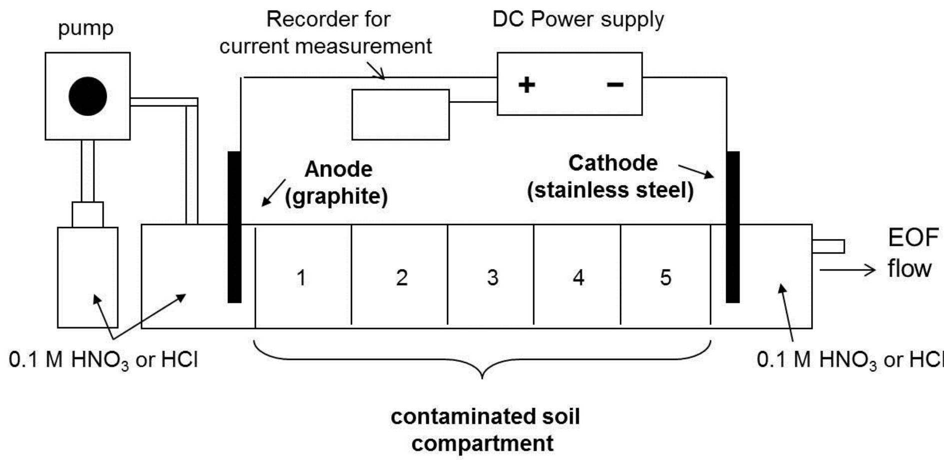

FIGURE 2. ELECTROKINETIC SET UP APPARATUS.

III. RESULTS AND DISCUSSION

A. Characterization of soil

The physicochemical compositions of soils are shown in Table 1. It can be seen that all soils in similar texture which is sandy loam, while they all have high CEC values and organic matter content. Therefore, they display high permanent charge and CEC was due to the variable charge components [18]. The quantify of buffering capacity of the soil samples is represented by plotting the $d\log V_{NaOHadded}$ and the $d\log\ V_{NaOHadded}$ versus dpH (the curves are not shown). The slopes of the curves indicated that the larger the slopes are, the smaller the buffer capacity is. The calculated slopes show that soil A and B have a strong buffering capacity against base (e.g. $d(\log V_{NaOHadded})/d\mathrm{pH}$) = -0.594 and 0.479), but the pH changed slightly when acid was added to the soil C and D (e.g. $d(\log V_{HCladded})/d\mathrm{pH}$) = -0.423 and 0.367). Therefore, it seems that both of A and B soils to have any quiet lower buffer capacity against acid compared with that soil B and C which have quiet higher buffer capacity against base. In addition, high amounts of heavy metals are retained in solution when the buffer capacity is high enough to resist a change in the pH soil into the alkaline condition [19-20]. Therefore, for EK testing, soil of A and D were using as a silver amended soil in regard to evaluate the influence of buffer capacity on the EK remediation process.

B. Electrokinetic remediation process

Fig. 3 shows the amount of silver remaining in the each part of the filled soil in the migration cell after 72 h of EK process. The results show that silver was accumulated in the soil after the EK process was different depend on an acid that used as electrolyte in electrolytic process. For example, in soil A when using nitrate acid as electrolyte, silver was hardly diminished from soil after EK process (Sec. 1 to 3) and accumulated near the cathode (Sec. 4 to 5). This suggested that the nitrate acid better acted as electrolyte than that chloride acid to remove silver ion on the adsorption of soil A. On the other hand, in the EK system with soil C, silver ion was distributed randomly in the contaminated soil after the EK process, but still nitrate acid was the only electrolyte that can remove silver ion from soil. The low removal capacity in the case of soil C seemed to be due to the low current density during the EK operation, that is the

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high clogging of precipitate of metal hydroxide in the soil matrix might increase the electric resistance in the EK system [21].

TABEL 1. PHYSICOCHEMICAL OF SOIL THAT USED IN THE STUDY

Parameters	Soil code			
	A	B	C	D
Particle size distribution (%) :				
Sand	66.43	64.35	51.84	68.16
Silt	23.09	24.35	36.05	23.68
Clay	10.48	11.31	12.11	8.16
Soil texture	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Organic C (%)	0.83	1.64	1.47	4.27
Organic matter (%)	1.43	2.83	2.54	4.27
Total N (%)	0.09	0.05	0.11	0.14
CEC (meq/100 g)	12.35	16.83	18.06	16.95
Surface area (N_2-BET), m^2/g	25.672	35.095	40.688	28.456
Pore volume, m^3/g	52.372	64.015	64.109	50.168
pH (1:20, w/v)				
Buffer capacity :				
d(logVHCladded)/*d*pH	-0.422	-0.310	-0.423	-0.367
d(logVNaOHadded)/*d*pH	-0.594	-0.479	-0.391	-0.382

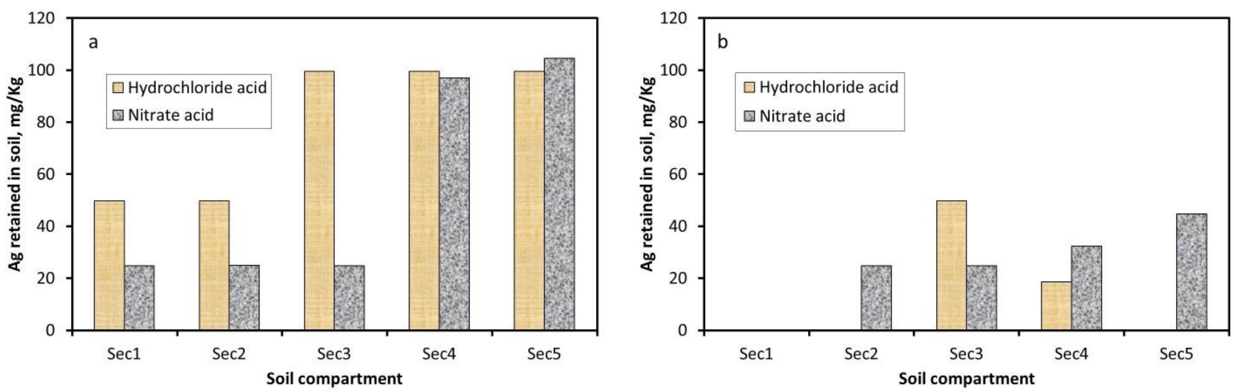

FIGURE 3. RESIDUAL DISTRIBUTION OF SILVER CONCENTRATION IN THE SOIL AFTER 7 D OF ELECTROKINETIC PROCESS. CONCENTRATION PROFILES IN SOIL A (A) AND SOIL D (B)

IV. CONCLUSION

In this study, the application of electric across the contaminated soil with silver, causes Ag^+ to migrate from anode to cathode, accompanied by marked changes in the silver concentration consecutively from soil compartment (Sec. 1

to 5). In regard to remove silver from soil, nitrate acid is more effective as flushing solution than that hydrochloride acid. Silver metal was tightly bond with soil from Kotagede since these soils have high carbon contents and low buffer capacity against base solution.

ACKNOWLEDGMENT

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C – 14

Synthesis 1-Propanol from Propanoic Acid

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***Abstract*—**Synthesis of 1-propanol from propanoic acid had been done. Polypropylene was synthesized via two steps. They are; esterification of propanoic acid and methanol in the presence of sulfuric acid catalyst with mole ratio of 1:1 to produce methyl propanoate, and reduction of methyl propanoate with natrium using ethylene glicol as solvent to yield 1-propanol. Structural characterization of methyl propanoate and 1-propanol was done by means of IR, and GC-MS spectrometers. The results show that esterification of propanoic acid with methanol produced methyl propanoate in 75% yield and reduction of methyl propanoate produced 1-propanol in yield of 31%.

Keywords:*propanoic acid, 1-propanol, esterification and reduction*

I. INTRODUCTION

Because of good combination of chemical and physical properties along with low cost, excellent processibility, polyolefins are widely used in our modern life [1-3]. Low isotactic polypropylene is a problem in polypropylene industry. Now, it has more attention and is widely used as adhesives, sealants and coatings, additives for building to grade high way [4-5]. It has been reported that the atactic polypropylene could be synthesized with some metallocene compound [6-7], although metallocene catalytic system needs a great quantity of expensive methylaluminoxane (MAO) as cocatalyst and the existing equipment and technological process also must be changed if using metallocene cataytic system. Therefore much effort has been put on the development and research to produce polypropylene (PP).

Polypropylene can theoretically be obtained from 1-propanol using acid catalyst. Thus, the transformation of propanoic acid into 1-propanol can be seen as an indirect attempt to produce polypropylene.

In the paper, 1-propanol is synthesized. The esterification reaction and external electron donor in reduction reaction are studied in detail.

II. MATERIALS AND CHARACTERIZATION

The main materials used are: propanoic acid (100%), ethanol, H_2SO_4 (98%), natrium bicarbonate ($NaHCO_3$), natrium sulfate anhydrous (Na_2SO_4), natrium (Na), ethylene glycol, HCl (36%), For characterization, we used Infrared spectrometer (IR, Shimadzu Prestige-21), Gas Chromatography (GC-Hewlett Packard 5890 series II) and Gas Chromatography-Mass Spectrometer (GC-MS, Shimadzu QP-2010S).

III. METHODS

A. *Methyl propanoate synthesis*

45 mL (0.6 mol) propanoic acid, 25 mL (0.6 mol) methanol and 2 mL sulfuric acid were added in the reflux system. The mixture was refluxed and stirred with a magnetic stirrer for 14 h. The product was distilled at a temperature of 70-80°C. Then, it was exctracted with 10 mL of 10% $NaHCO_3$. The bottom layer was separated and the top layer is dried with anhydrous Na_2SO_4. The product was weighed, and analyzed by GC, and IR Yield : 34 g (0.4 mol)

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B. 1-propanol synthesis

7 mL (0.07 mol) methyl propanoate was added in a 100 mL three neck flask with 3.30 grams (0.14 mol) of natrium. The mixture was stirred with a magnetic stirrer and heated with an oil bath. After the natrium melting, we added ethylene glycol 15 mL (0.24 mol). (Added as soon without removing the reflux system). The mixture was refluxed for 1 h. The product was distilled at temperature of 90-100 °C. The product was weighed, and analyzed by GC-MS and IR. Yield : 1.9 g (0.032 mol)

IV. RESULTS AND DISCUSSION

A. Methyl propanoate synthesis

An esterification reaction is a reaction of alcohols and carboxylic acids catalyzed by strong acid to produce an ester. The mol ratio of propanoic acid and methanol using H_2SO_4 as a catalyst in this paper is 1:1. Synthesis is done with the addition of the reactants and then refluxed for 14 h [8]. Reaction mechanisms of the esterification is in Figure 1

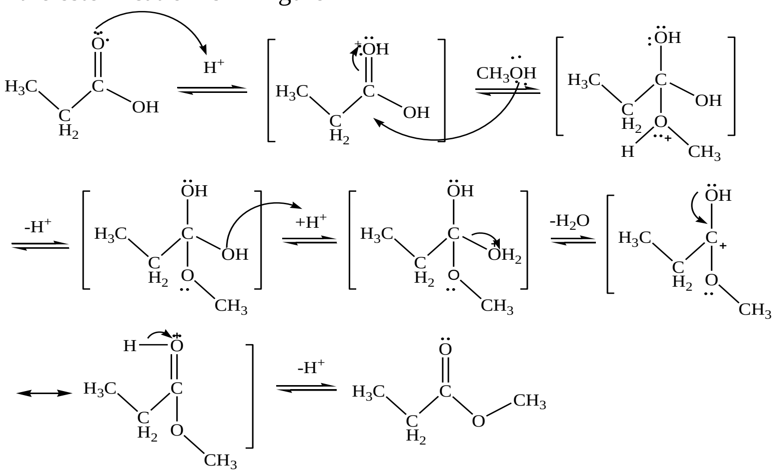
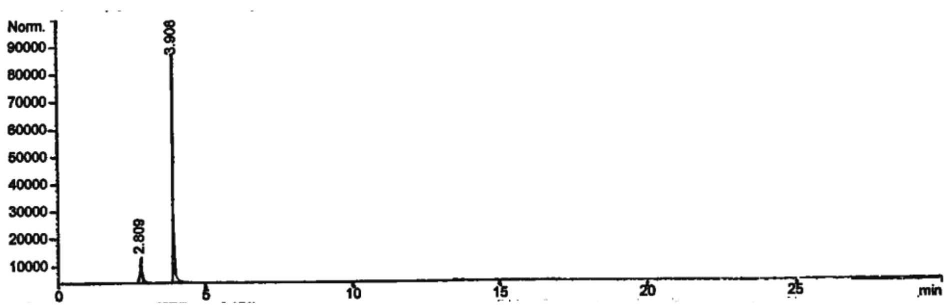
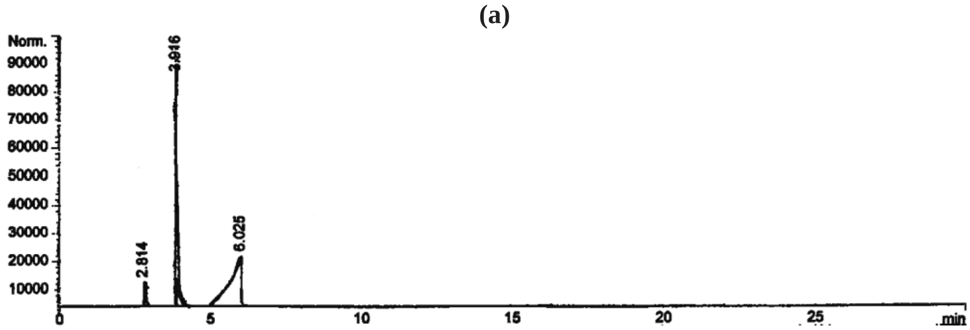


FIGURE 1. MECHANISM OF ESTERIFICATION REACTION

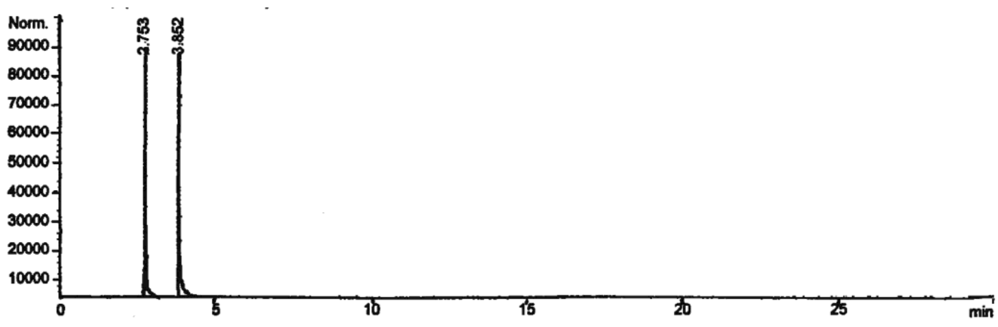
The esterification reaction of propanoic acid and methanol with sulfuric acid catalyst will produce methyl propanoate. The results of GC analysis of the product is compared with chromatograms of the esterification reaction that have been added by propanoic acid and methanol in Figure 2.



(a)



(b)



(c)

FIGURE 2. CHROMATOGRAM (A) METHYL PROPANOATE PRODUCT (B) SPIKING PROPANOATE ACID TO METHYL PROPANOATE PRODUCT, AND (C) SPIKING METHANOL ON METHYL PROPANOATE PRODUCT

Based on Figure 3 (a), the peak at a retention time (t_R) 3.908 minutes with a percentage of 97% is expected to be the product, methyl propanoate. The new peak have appeared at retention time (t_R) 6.025 minutes after spiking with propanoic acid and the first peak at a retention time (t_R) 2,809 minutes have increased the percentage from 2.7% to 31% after spiking with methanol. Thus, it is estimated that there is still a little methanol in the product.

The results of the analysis using IR spectrometer provides a spectrum in Figure 3 and the data analysis is in Table 1.

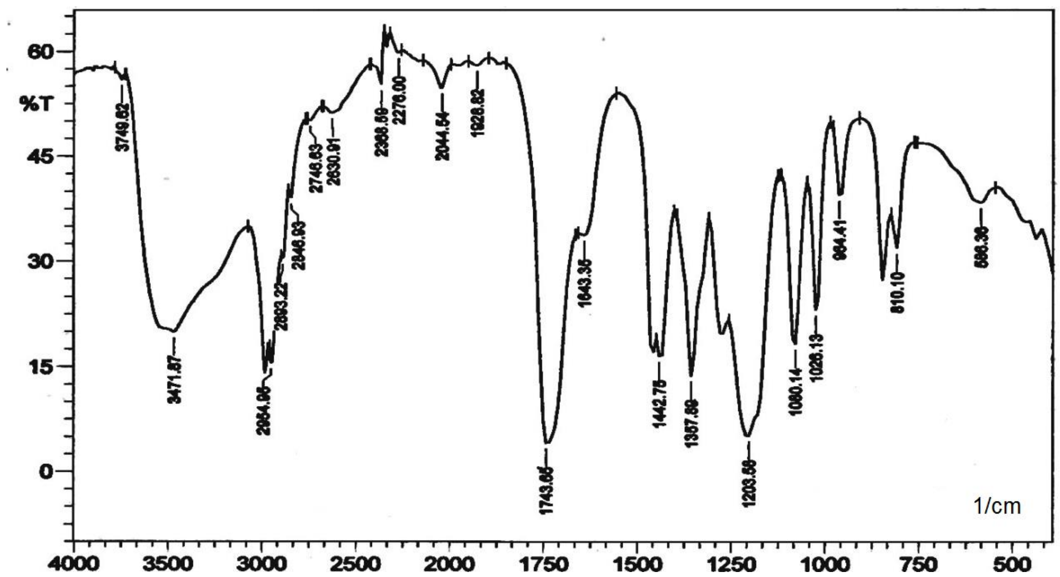


FIGURE 3. INFRARED SPECTRUM OF METHYL PROPANOATE

At 3471 cm^{-1} region showed a vibration range of hydroxyl (OH) methanol remaining in fractions of methyl propanoate . Uptake was observed for a residual alcohol resulting in the vibration range of the C-O at 1080 cm^{-1} region . Uptake sharply with strong intensity in the area of 1743 cm^{-1} is the vibration of the carbonyl group (-C = O) ester and reinforced by their absorption at 1203 cm^{-1} indicates that the vibration range -C - O - C- ester.

Absorption at wave numbers 2954 and 2846 cm^{-1} is a stretch vibration absorption Csp^3 - H in the alkyl group. Uptake in the area in 1443 and 1358 cm^{-1} indicate the presence of C - H vibration bends methylene group ($-CH_2-$) and vibration of C - H bend a methyl group ($-CH_3$)

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TABEL 1. INFRARED SPECTRUM DATA OF METHYL PROPANOATE

Wavenumber (cm^{-1})	Functional group
3471	−OH alcohol
1080	−C−O alcohol
1743	−C=O carbonyl
1203	−C−O−C−
2954 and 2846	Csp^3-H
1443	$-CH_2-$
1358	$-CH_3$

B. 1-propanol synthesis

The reduction reaction in methyl propanoate is produced methanol and propanol. GC analysis of the 1-propanol fraction of the reaction product from reduction in methyl propanoate (Figure 4) showed a major peak which is estimated from propanol 74.55% at a retention time (tR) 2,368 minutes.

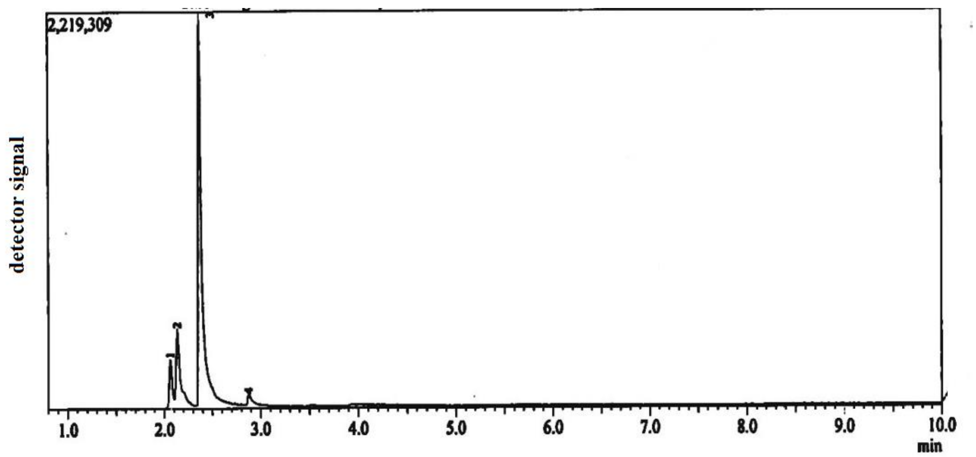

FIGURE 4.CHROMATOGRAM OF 1-PROPANOL PRODUCT

From the results of the GC, it present of several peaks. It can be seen the main peak (peak 3) is 1-propanol, other components that appear on the chromatogram is a residual reactant. MS analysis results of 1-propanol are shown in Figure 5

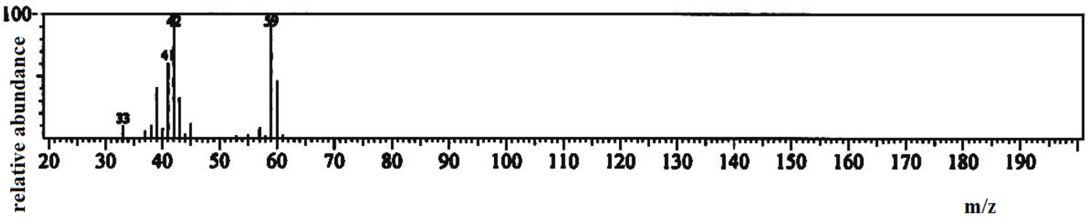

FIGURE 5. MASS SPECTRUM OF 1-PROPANOL PRODUCT

The mass spectrum of Figure 5. shows that result is similar to 1-propanol. Analysis the mass spectrum of 1-propanol product is as follows:

m/z	33	41	42	59

1-propanol has one functional group that is hydroxyl (-OH), the fragmentation is derived from one kind of ion molecule that is the loss of one of the lone pairs of electrons (n) on the oxygen atom. Molecular ion at m/z 60 corresponding to the molecular weight of the 1-propanol looks small. This indicates that the compound is not stable so the fragmentation produces a peak at m/z 59. The peak at m/z 59 is the base peak that comes from the release of the group H. The peak at m/z 42 and 41 is another peak caused loss of H_2O molecules (BM 18) from the molecular ion peak and essentially it is the hallmark of alcohol. Fragment at m/z 33 is a fragment CH_3-H_2O^+ that produced by the loss of C_2H_2 (M^+-27). The pattern of fragmentation that occurs in an estimated reduction reaction results as in Figure 6. The mechanism of recduction reaction in methyl propanoate using metal sodium in ethylene glycol solvent is written in Figure 7.

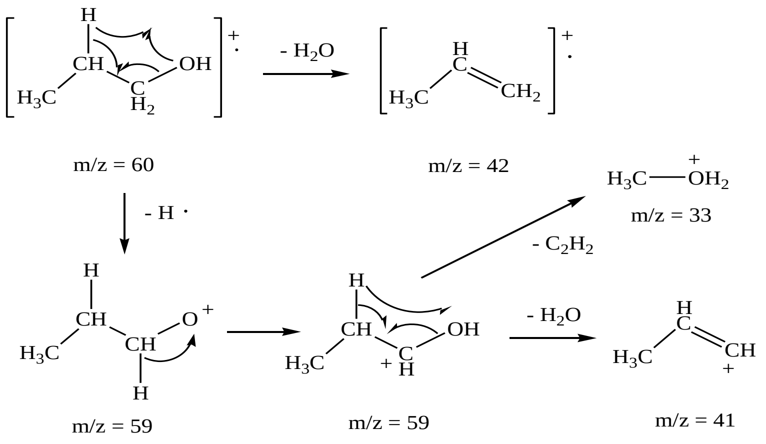

FIGURE 6. FRAGMENTATION ION OF 1-PROPANOL

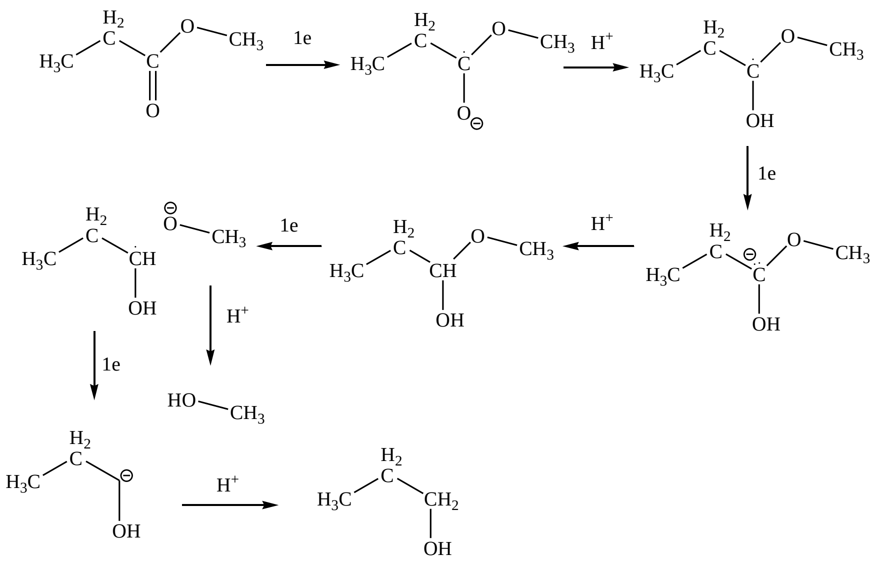

FIGURE 7. MECHANISM OF 1-PROPANOL REDUCTION

Reduction of methyl propanoate is written on the mechanism marked the acceptance of electrons from the sodium metal. Electrons formed by dissolving metallic sodium in ethylene glycol. When ethylene glicol become a solution, it will turn into a metal cation and can provide electrons. Methyl propanoate which will be reduced accept an electron, and turn it into a radical anion. In the presence of protons, undergo radical anion protonation into another radical form which then will receive another electron to form the alcohol in this case methanol and propanol.

V. CONCLUSSION

Analysis by GC and IR shows that the propanoic acid could be esterification with methanol (1:1) using sulfuric acid catalyst produced methyl propanoate as a main component with a purity of 97 %. From the results of this research can be ascertained that the sodium metal can reduce methyl propanoate into methanol and 1-propanol. 1-propanol product obtained has a purity of 75% aof the results.

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C – 15

PAPER INDICATOR OF WORA-WARI FLOWERS (*Hibiscus rosa-sinensis* L.)

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Abstract--Chemicals is very expensive, to use for practicums of senior high school in Central Sulawesi still lacking. The research about making of the indicators of Wora-wari flowers as a substitute for red and blue litmus already done. Wora-wari flowers are extracted with ethanol, then the extract is isolated the active compound which serves as an indicator, then the paper has been activated by acid then macerated to a solution of isolated compounds until 30 minutes, then aerated to dry. Trials with an acid solution is a red indicator and an alkaline solution become blue.

Keywords*: wora-wari flowers (Hibiscus rosa-sinensis* L*), indicator paper, red and blue litmus replacement.*

I. INTRODUCTION

Curriculum enactment in 2013, contextual learning is preferred. On the subjects of chemistry, study lab is a part that can not be abandoned, due to study the chemical changes required proof of theory and real observations in the laboratory. For example, to distinguish acid solution with a base that is both colorless, it is necessary to distinguish acid-base indicators .

Indicators of synthesis of methyl orange, phenolphthalein, litmus paper is often used for chemical laboratory experiments are expensive, because the processes and materials used synthesized (Nuryanti et al., 2010). The synthetic indicator is needed for the lab in secondary schools and universities. Therefore, we need a way to replace this indicator with natural materials that are easily obtainable and cultivated.

Plant parts (stems, leaves, fruits and flowers) are colored usually contain pigment types flvonoid. Of the class of compounds that have a wide range of attractive colors are a group of anthocyanin. Anthocyanins are red, blue, green and even colored, depending on the pH. Therefore, the plant parts are colored and contain anthocyanins can be used as a base material for making acid-base indicators (Nuryanti et al., 2010).

Previous research has been done is the isolation of anthocyanins pelargonidin of interest wora-wari flowers. Pelargonidin anthocyanin color change in a solution of acid (CH_3COOH, HCl, H_2SO_4) is red, while the color changes in an alkaline solution (NaOH, $Ca(OH)_2$, KOH) blue (Nuryanti, et al., 2010). Based on the fact discoloration pelargonidin anthocyanins contained in the wora-wari flowers, once isolated can be used as an alternative to the basic indicator litmus paper red and blue.

Red and blue litmus is needed for laboratory experiments in high school in Palu, Central Sulawesi, but the indicators are difficult to obtain (to go through the booking because the chemical is so far still imports). Therefore, the objective of this research is to make paper acid-base indicators of interest wora-wari flowers, as an alternative to litmus.

The benefits of this research is as an alternative to the red and blue litmus. Besides the success of this research can increase the value of the interest ekomonis wora-wari flowers, during which only functioned as a hedge plant yard. And the fundamental benefits of this research to assist the government in the field of education, especially in overcoming obstacles in the practical implementation in secondary schools in rural areas. Long-term benefits are reducing imports of acid-base indicators, especially red and blue litmus indicator.

II. RESEARCH METHODS

Materials

Materials used in this study were: n-hexane, methanol, ethanol, ethyl acetate, TLC plates, silica gel 60, 70-230 mesh, HCl 1% (v/v methanol), n-buthanol, Whatman paper no. 1, red and blue litmus. Wora-wari flowers from Petobo, Sigi Biromaru, Palu, Sulawesi Central Indonesia.

Equipments

The instrumens used in this study were: shaker for extraction (IKA® KS 130 basic), Buchii evaporator (R-124), electric bath, dryers, Buhner funnel, analytical balance (Metler AT 200), FT-IR (shimadzu Prestge-21), TLC scanner (Camac3), UV-Vis (array Miltonroy 3000), 500 MHz 1H-NMR and 13C-NMR 125 MHz (JEOL JNM ECA 500), micro pipettes (SOLOREK Switzerland), pH meter (Hanna HI 8314), Column chromatography (length 60 cm, diameter 2 cm).

Research Procedures

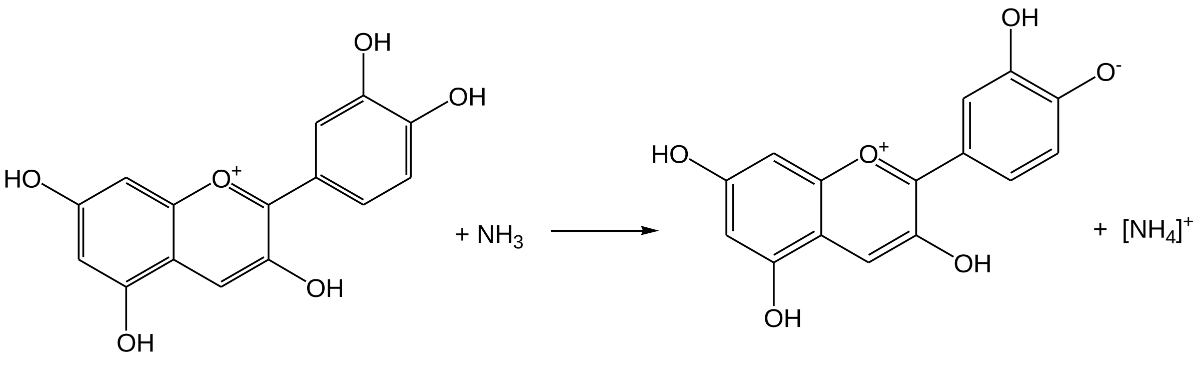
Extraction of Wora-wari flowers. Wora-wari flower buds were weighed as much as 500g of interest red still fresh, then cut into small pieces, then put in a dark bottle, after it is extracted with a solvent level of different polarity. Extraction by maceration worked closely with the procedures work done Nuryanti, et al., 2013.

Isolation anthocyanidin of wora-wari flowers. Isolation of extract wora-wari flower preceded by thin layer chromatography (TLC). Procedurs and the type of solvent equal to the procedures of Nuryanti et al., 2012. Than, the separation of anthocyanidins by column chromatography (CC). Identification of anthocyanidins structure by UV-Vis, FT-IR, 1H-NMR and 13C-NMR (Adji et al., 2008).

Paper making indicators as an alternative to litmus. Paper activated by maceration using acid to absorb the anthocyanin. After that aerated to dry, then soaking in a solution of anthocyanins isolated up red paper. Than aerated to dry paper. Once dry test was done with a solution of acids and bases. As a comparison, indicators which are litmus paper red. Paper making alternative indicators penganti blue litmus done in the same way, but the activation of the paper using an alkaline solution.

III. RESULTS AND DISCUSSION

Extraction of wora-wari flowers. The result of extraction with methanol, obtained extract is red, after identification by the NH_3 vapor to form blue color, this indicates the presence of anthocyanins. The blue color produced in this study suggested the formation of complex compounds between the vapors NH_3 with anthocyanin forming quinoid bases, in consequence of the loosed H from the acidic OH group on the cation flavilium in the anthocyanin molecule (Figure 1).



red blue

Figure 1 The reaction between anthocyanins cyanidine with NH_3 vapor (Nuryanti, et al., 2012)

The results of the analysis by UV-Vis spectrophotometer showed maximum wavelength (λmaks) 537 nm. According to Andersen and Markham (2006) has an absorption characteristic of anthocyanin λmaks region between 465-560 nm. The results of the analysis concludes methanol extract containing anthocyanin.

The wora-wari flowers extract obtained was red extract as much as 56.51 g. Color test with ammonia vapor gave color change from red to blue as the contained anthocyanin was reacted with ammonia vapor to give quinoid base (Jackman *et al*, 1987).

According to UV-Vis analysis, there were two maximum wavelength on 537 (band I) and 279 (band II) nm. Thus, it could be indicated that wora-wari flowers, contained the anthocyanin. Having isolated by chromatographic method with eluent of n-butanol-HCl 1% (4:1,5), red powder was obtained in 2.78 mg.

FT-IR analysis showed the presence of intramolecular hydrogen bond of C-H aromatic at 3035 cm^{-1}. This was supported by the absorption of C-H at 2924 and 2856 cm^{-1}. Absorption at 1584,21 cm^{-1} came from conjugated aromatic ring and strong absorption at 944 cm^{-1} represented aromatic C-H bond. Additionally, the broad absorption band at 3425,64 cm^{-1} were characteristic for intra molecular hydrogen bond of hydroxy groups. Absorption band at 2123 cm^{-1} indicated the presence of di-substituted double bond. The strong absorption band at 1635,50 cm^{-1} represented aromatic -C-O-C- bond. This strengtened by the presence of strong absorption at 1080 cm^{-1}. The presence of –C-O-C- was reinforced by no absorption around 1700 cm^{-1}, characteristic for carbonyl group. With the data, it can be ascertained that the carbonyl group contained in the aromatic ring was –C=O-C- (Silverstein et al., 1991).

Interpretation of the-COC-emergence is reinforced not absorption around 1700 cm-1, which are characteristic of carbonyl groups (-C = O). With these data can be ascertained carbonyl groups contained in the ring aromatic is-C = OC-that appear in the wavenumber region 1653 cm-1 (Silverstein et al., 1991).

Based on ^{1}H-NMR analysis, there were 7 peaks depicting 7 protons with different chemical environment. Signal (δ 9.0341 ppm, singlet, 1 H) described proton of C-4 on ring C. Signal (δ 8.2898-8.2729 ppm, doublet, J = 8.50 Hz, 1 H) dan (δ 7.0345-7.0174 ppm, doublet, J = 8.50 Hz, 1 H) showed two aromatic protons of ring B which were in ortho position each other, there were proton of C-5' and C-6', respectively. Signal (δ 8.0515-8.0490 ppm, doublet, J = 1.25 Hz, 1 H) came from proton of C-2' which were in *meta* position to proton of C-6'. Furthermore, two singlet peaks (δ 6.9038 ppm, singlet, 1 H) dan (δ 6.5666 ppm, singlet, 1 H) represented two protons on ring B, i.e. on C-8 and C-6. The sugar group was shown by the absorption with total integration of 7 proton in the region of 3.9006-3.3103 ppm. According to Marbry et al (1970), protons of ring A (H-6 and H-8) gave signals at δ = 6.80 and 7.10 ppm, while those of ring B appeared in the region of δ = 7.50-7.70 ppm.

Based on UV-Vis, IR and ^{1}H-NMR analyses as well as supported by color test using ammonia vapor, it could be stated that wora-wari flowers (*Hibiscus rosa-sinensis* L) had anthocyanidin of cyanidin-3-glucoside (Figure 2).

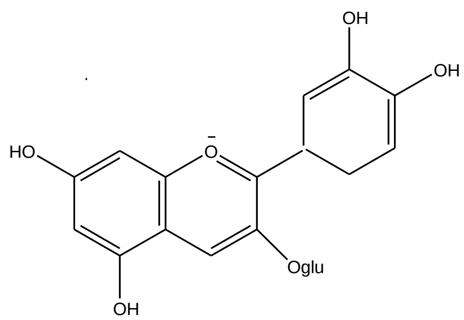


Figure 2. Structure cyanidin-3-glucoside

Paper making indicators as an alternative to litmus. Paper once activated with a solution of HCl 1%, then macerated with a solution sianidin-3-glycosides turns red. This was cultured caused by cations flavilium the anthocyanin molecule is stable in acidic solution (Laleh et al., 2006).

Paper indicator red color, when immersed in an alkaline solution, there will be a reaction of H atoms in the OH groups in the cation flavilium, that will form the quinoid bases, and there will be expansion of delocalisation, causing discoloration of stronger intensity and produces a blue color, Quinoid bases or anhydrobase provide the absorbance at λ maks 610 nm (Ologundudu et al., 2009). Changes in the structure of anthocyanin influence of pH, as shown in Figure 3.

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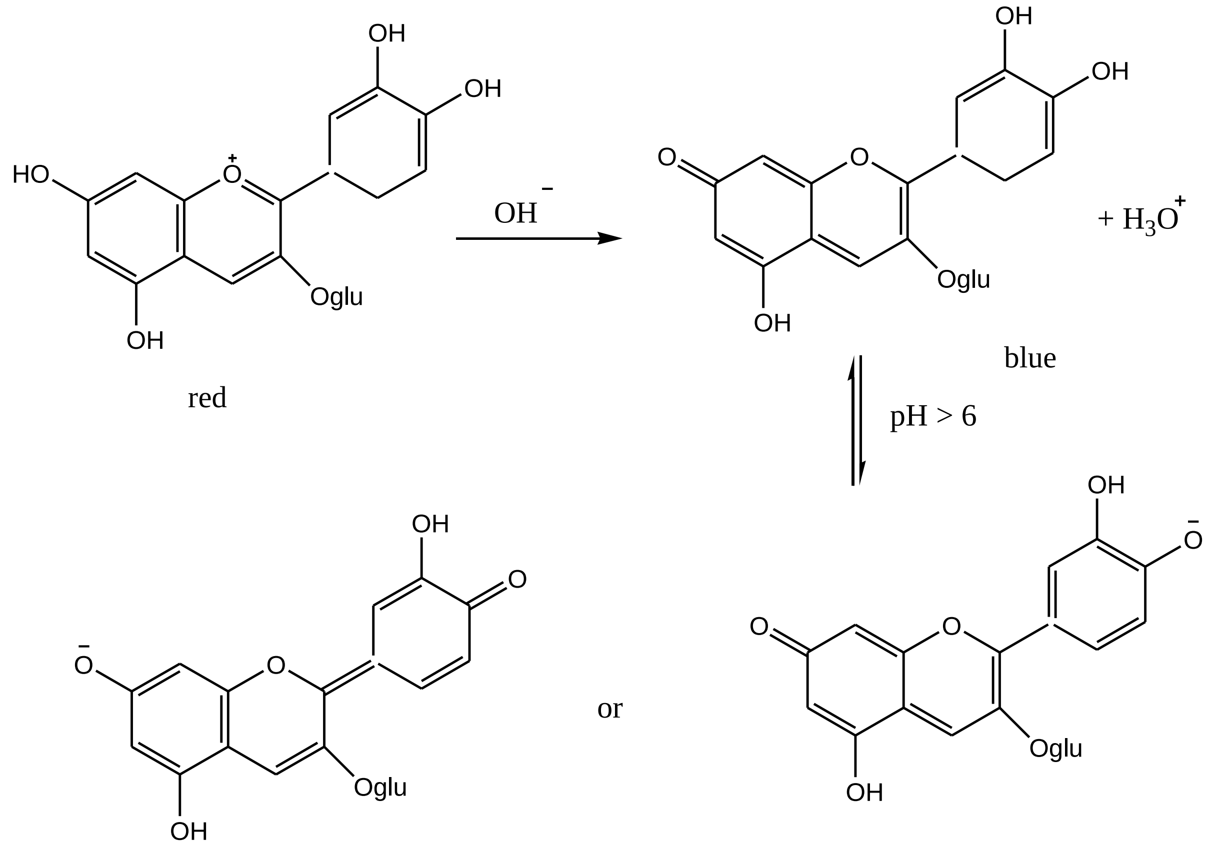

Figure 3. Changes in the structure of anthocyanin influence of pH

IV. CONCLUSIONS

Wora-wari flowers is contain anthocyanins cyanidin type. Indicator paper made from wora-wari flowers, in the acidic solutions was red and in the alkaline solution was blue.

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C – 16

DEVELOPMENT OF POTENTIAL KUNCI PEPET (*KAEMPFERIA ROTUNDA*) RHIZOMA PLANT AS ANTIOXIDANT

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Abstract— *Kaempferia rotunda* (Zingiberaceae), known as kunci pepet or kunir putih in Indonesia, has been traditionally used in as abdominal pain, sputum laxative, wounds and diarrhea colic disorder. This study was conducted to analize the total phenolic content and antioxidant activity of the extract chloroform of *K. rotunda*. The total phenolic content was conducted by Follin Ciocalteu method and using gallic acid as standart phenolic. Antioxidant activity test was conducted by β-carotene bleaching method and 1.19-diphenyl-2-picrylhydrazyl (DPPH) method. The result of this research shows that total phenolic content of chloroform extract amount 63.1 mg GAE/g sample. The antioxidant activity by β-carotene bleaching method shows IC_{50} 265.45 µg/ml, and by DPPH method shows IC_{50} 25.20 µg/ml.

Keywords: Kaempferia rotunda; antioxidant; total phenolic content, β-carotene bleaching; DPPH

I. INTRODUCTION

Kaempferia rotunda is one of the plants belonging to the genus *Kaempferia* family Zingiberaceae. In Indonesia, this plant is known by local names kunci pepet, temu rapet (Java), kunir putih (Sunda), konce pet (Madura), temu putri (Malay). Rhizome of this plant is widely used traditionally to treat abdominal pain, laxative sputum, wound and colic disorders diarrhea. This plant is used in folk medicine system of Bangladesh for the treatment of high blood sugar levels commonly observed in patients with diabetes, as well as for the treatment of pain. This plant is considered as an important medicinal plant also in ancient Indian system of traditional medicine, namely, Ayurveda. Ayurvedic medicine, hallakam, contain tubers of plants considered as stomachic, anti-inflammatory cuts and bruises, and are useful for the treatment of mental disorders and insomnia [1; 2]. The plant and rhizomes of *K. rotunda* can be seen in Figure 1.


Figure 1.The plant and rhizoma of *K. rotunda*

The reseach of bioactive potential of rhizome this plant has been widely studied, among others, as an antioxidant, anti-peroxidation of lipids, diabetes mellitus, liver damage, atherosclerosis, rheumatoid arthritis, antimutagenic, cytotoxic, and anticancer [3;4;5;6]. From the results of these studies indicate that kunci pepet rhizomes contain a variety of compounds with the potential to be developed as a drug. Stevenson *et. al.* [7] reported nine new isolated compounds from methanol extracts of rhizomes of *K.*

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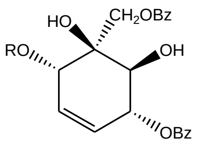
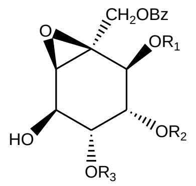
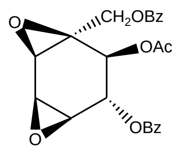
rotunda, that reportedly contained six polyoxygenated cyclohexane derivatives identified as (-)-6-acetylzeylenol (1), zeylenol (2), four acylated derivatives of 1-benzoyloxymethyl-1,6- epoxycyclohexan-2,3,4,5-tetrol (3-6), a Diels-Alder adduct of 3-benzoyl-1-benzoyloxy-methylcyclohexa-4,6dien-2,3-diol (7), crotepoxide (8), and 2-(benzoyloxymethylphenyl-(3,6-di-O-acetyl)-β-glucopyranoside (9). Lotulung *et.al* [3] reported two compounds has been identified from rhizomes of the plant, namely, 2'-hydroxy'-4,4',6'-trimethoxy-chalcone and (+) crotepoxide, the first possessing antioxidant activity. Three known flavanone can be isolated from chloroform extract from *K. rotunda*, namely 5-methoxy-7-hydroxy-flavanone, 5-hydroxy-7-metoksi-flavanon, and 5.7-dihydroxyflavanone [5]. Structure of the isolated compounds from *K. rotunda* can be seen at figure 2.



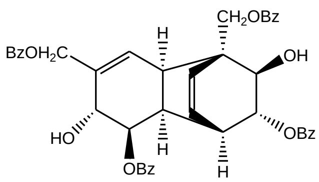
1.R = Ac, (-)-6-acetylzeylenol
2.R = H, zeylenol



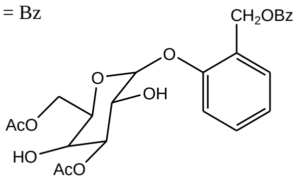
3. R1 = R3 =H, R2 = Bz,
4. R1 =R2 =H, R3 = Bz
5. R1 = Ac, R2 = Bz, R3 =H
6. R1 =Ac, R2 = H, R3 = Bz



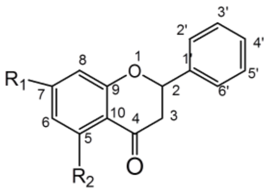
8. Crotepoxide



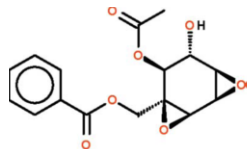
7. 3-Benzoyl-1-benzoyloxymethylcyclohexa-4.6dien-2,3-diol



9. 2-(Benzoyloxymethyl)phenyl-(3,6-di-O-acetyl)-b-glucopyranosida



$R_1 = OCH_3$; $R_2 = OH$, 5-hydroxy-7-methoxyflavanone
$R_1 = OH$; $R_2 = OCH3$, 5-methoxy-7-hydroxyflavanone
$R_1 = OH$; $R_2 = OH$, 5,7-dihydroxyflavanone



3-deacetylcrotepoxide

Figure2. Isolated compounds from *K. rotunda*

In this paper will discuss the results of the determination of phenolic and antioxidant activity test of rhizomes *K. rotunda.* The total phenolic content was conducted by Follin Ciocalteu method and using gallic acid as standart phenolic. Antioxidant activity test was conducted by β-carotene bleaching method and 1.19-diphenyl-2-picrylhydrazyl (DPPH) method.

II. MATERIAL AND METHOD

Apparatus and reagent

Glassware, analytical balance, evaporator Buchi Rotavapor R-114, magnetic stirer, and Spectronic 20 (Genesys) were commonly used in this work. Chloroform extract *K. rotunda* rhizome, ethanol, amonia, $FeCl_3$ 2 %, β-caroten, chloroform p.a, aquades, linoleic acid, galic acid, Follin Ciocalteau reagent, Na_2CO_3 7 %, 1.19-diphenyl-2-picrylhydrazyl (DPPH, Aldrich), and ascorbat acid (Aldrich) were purchased and used without further purification.

Determination of total phenolic chloroform extract K. rotunda

A total of 0.4 mL sample at a concentration of 5000 mg / mL put in a 10 mL volumetric flask and add 0.4 mL Follin Ciocalteau reagent, shake and allowed to stand for 5 minutes. Added with 4 mL reagent

Na_2CO_3 7% and diluted with distilled water to the mark, let stand for 50 minutes. Then the solution is measured at a wavelength of maximum absorbance of the solution at 760 nm. The standart curve used gallic acid at variation concentration 12.5 – 200 mg/mL.

Antioxidant activity of chloroform extract K. rotunda by β-carotene Bleaching method

Antioxidant activity test carried out by dissolving 2.5 mg of β-carotene powder in 1 mL of chloroform, and then the solution is evaporated at 40 °C for 20 minutes. The solution is added with 0.01 mL of linoleic acid and diluted with 30 mL of ethanol: distilled water (4: 1), shaken until homogeneous. From this solution 4.5 mL taken and put into a test tube which already contains 0.5 mL test sample with a few variations in the concentration of 10; 20; 30; 80; and 200 mg / mL, for a negative control sample was replaced with ethanol. Prior to incubation, the sample solution and negative control measured this absorbance (A_0 and A^0C) at maximum wavelength. Furthermore, solution was incubated at 50 °C for this reaction. Then each solution was measured absorbance after the end of incubation (At and At_o). This data will be used to determine the antioxidant activity of chloroform extract *K. rotunda*.

Antioxidant activity of the chloroform fraction of K. rotunda by DPPH method

The antioxidant activity of chloroform fraction of. *K. rotunda* we tested the free-radical scavenging activity. 1.19-diphenyl-2-picrylhydrazyl (DPPH) was used as the source of free-radicals. The extract diluted in ethanol for the analysis. 5 ml of the extract was mixed with 5 ml methanolic solution of DPPH (0.12 mM) and kept in dark at room temperature for 30 minutes. The DPPH scavenging activity was determined spectronic 20 (Genesys) at 516 nm against DPPH solution as control. The samples were tested in triplicates. The antioxidant activity was calculated as percentage of DPPH that was decreased in comparison with the control and was calculated with the formula:

$$\% \text{ Antioxidant activity} = \frac{[\text{A control- A sample}]}{[\text{ A control}]} \times 100\%$$

Therefore, the inhibition activity could be calculated to determine IC_{50}.

III. RESULT AND DISCUSSION

The research used gallic acid solution as standard solution. Gallic acid solution have yellow-green after being added with the Folin-Ciocalteu reagent and becomes a dark blue after adding reagent Na2CO3 7%. Based on the results of measurements using a spectrophotometer, obtained the maximum wavelength of 760 nm. Operating time is determined by measuring the absorbance of the gallic acid solution at a wavelength of 760 nm. Absorbance is determined every interval of 10 minutes until the absorbance data obtained were stable.

Standard solution used is a solution of gallic acid at a concentration of 12.5; 25; 50; 100; and 200 mg / mL. Each solution is made triplo and measured by spectrophotometry. Based on the measurement data gallic acid standard solution are presented in Table 5, obtained by the linear regression equation for the determination of total phenolic content is $y = 0{,}004x + 0.015$, $R^2 = 0.997$. Furthermore, from the gallic acid standard curve is used to determine the levels of gallic acid equivalents (x) of 126.25 mg / mL, so that the total phenolic content of the chloroform extract *K. rotunda* of 63.1 mg GAE / g.

Chloroform extract of. *K. rotunda* was tested for antioxidant activity using β-carotene bleaching method and DPPH. This method used ascorbic acid as positive control. The results of the determination of antioxidant activity of chloroform extract *K. rotunda* using both methods are presented in Table 1.

The β-carotene bleaching method is a method of determining the antioxidant activity indirectly. In this determination using β-carotene which will react with peroxide radicals formed by oxidation of linoleic acid [8;9]. The absorbance of the solution is measured at a wavelength of 451 nm. The relationship between concentration and antioxidant activity shows in Table 1. From the calculations, the linear regression equation $y = 0.099x + 23.72$. The calculation of chloroform extract of *K. rotunda* values obtained of IC_{50} 265.45 mg / mL. The reagent used in this β-carotene bleaching method, such as β-carotene as an antioxidant activity indicator, linoleic acid as a source of free radicals and active compounds from chloroform extracts *K. rotunda* as inhibiting the oxidation reaction. Antioxidant activity of the test sample compared to the negative control (blanco). Blanco is a system solution β-carotene-linoleic acid that does not contain extract. The antioxidant activity was assayed by measuring the absorbance of the initial sample before the end of incubation and after incubation using a spectrophotometer at a wavelength of 451 nm.

The wavelength selection due to β-carotene absorption was strongest when λ 451 nm. The solution samples were incubated at 50 °C for 70 minutes, because at these temperatures is considered to have oxidized linoleic acid is thermally generate free radicals. Linoleic acid oxidation reaction shows in figure 2.

Table1. The inhibition activity (IC_{50}) of chloroform fraction *K. rotunda* and ascobic acid by β-carotene bleaching method and DPPH

Sample	β-carotene Bleaching method				DPPH method			
	C	A	Persamaan regresi	IC_{50} μg/mL	C	A	Regresion	IC_{50} μg/mL
Chloroform fraction of *K. rotunda*	10 20 30 80 200	23.28 26.52 28.54 30.16 43.93	y = 0.099x + 23.72 R^2 = 0.966	265.45	250 62.5 31.25 15.625	76.46 61.86 49.81 43.96	y = 0.123x + 46.90 R^2 = 0.872	25.20
Positive control (Ascobat acid)	10 20 30 40 50 60 70 80	76.79 68.93 51.79 47.50 35.00 24.29 5.00 1.07	y = -1.124x + 89.36 R^2 = 0.986	35	6.25 3.125 1.562 0.781 0.390	82.5 41.54 21.23 10.54 5.39	y = 13.15x + 0.388 R^2 = 1	3.77

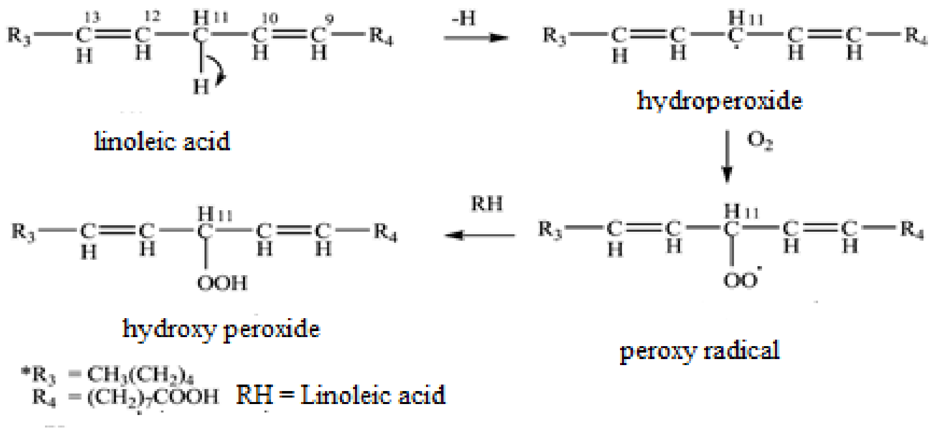


Figure 2. Linoleic acid oxidation reaction

Furthermore, peroxide radicals will attack conjugated double bond of β-carotene. So it would occured the following reaction:

LOO^* + β-caroten $\longrightarrow$ β-carotene bleaching (decay orange to yellow to colorless)

The loss of conjugated double bonds β-carotene cause bleaching orange color in the solution indicated by the declining value of absorbance after incubation process. The addition of chloroform extract of *K. rotunda* shown to inhibit the oxidation of β-carotene and linoleic acid during incubation process takes place. Antioxidant compounds will donate hydrogen atoms to stabilize free radicals from linoleic acid. So it would occured the following reaction:

$$LOO^{*} + AH \longrightarrow LOOH + A^{*}$$

Antioxidant activity test by DPPH method, that is based on the reaction of DPPH radical arrest by antioxidant compounds through the oxygen atom transfer mechanism, which will produce DPPH-H molecule non-radical form stable [10]. Reducing of the concentration DPPH indicated by a decrease in the intensity of the purple color of the previous. The DPPH scavenging activity was determined spectronic 20 (Genesys) at 516 nm against DPPH solution as control. The antioxidant activity was calculated as percentage of DPPH that was decreased in comparison with the control. Reaction arrest DPPH radical by the antioxidant shown in figure 3.

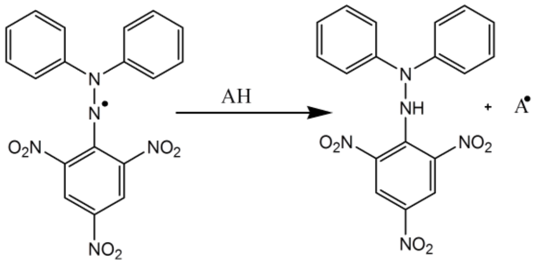


Figure 3. Reaction arrest DPPH radical by the antioxidant (AH)

Determination of antioxidant activity using two methods, namely β-carotene bleaching and DPPH showed almost similar data. Of the two types of such determination showed ascorbic acid had higher antioxidant activity compared with chloroform extracts of *K. rotunda*. The calculations of antioxidant activity using both of these methods are based on the value of IC_{50}. IC_{50} is the concentration of the sample is capable of providing inhibition of 50 %. IC_{50} value is inversely proportional to the ability of the samples that are antioxidants, the smaller the IC_{50} value showed stronger antioxidant activity [10].

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C – 17

The Development of Cinnamalacetone Synthesis Methode Based on *Green Chemistry Approach*

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Abstract—Cinnamalacetone synthesis based on green chemistry had been done. The purpose of this research was to improve the yields of cinnamalacetone (6-phenyl-3,5-hexadien-2-one) with the friendly synthesis method. Cinnamalacetone synthesis was done by condensation of cinnamaldehyde and acetone in 1:10 and 1:5 mole ratio, using NaOH as homogeneus catalyst at 10^0C in ethanol-water 1:1 as solvent. The effectiveness of heterogeneus catalyst was determined by comparing the use of HTc (hydrotalcite commercial) and c-HTc (calcined hydrotalcite commercial) on cinnamalacetone synthesis with NaOH as control. Further, cinnamalacetone synthesis was done by the same condition as describe before, but the solvent was water. The analysis of purity was performed using TLC and TLC scanner.

The result indicated that the optimal condition for friendly synthesis was shown by the mole ratio of cinnamaldehyde-acetone was 1:5, the heterogeneus catalyst was c-HTc, and the solvent was water.

Keywords: *green chemistry, hydrotalcite, cinnamalacetone*

I. INTRODUCTION

Green Chemistry is recently the most popular issue in industrial chemistry. Within this scheme, an environmental benign of chemical process to reduce and to remove industrial waste was investigated. For this purpose, research activity in organic synthesis can be conducted by reducing and choosing wisely reactant, catalyst and solvent.

Cinnamalcetone is one of important chemicals and intermediate in several industries. Cinnamalcetone is a product from crossed aldol condensation between acetone and cinnamaldehyde. Aldol condensation mechanism is themain route in this synthesis, and within the mechanism the reaction of two carbonyls in which one of them should have Hα. The reaction usually occurs over either base catalyst such as NaOH [1, 2] or acid catalyst such as sulfuric acid [3]. Ethanol or methanol can be chosen as the solvent, instead of other polar organic solvents [4].

Several principles of green chemistry have been applied and reported to develop more effective, simple, and environmentally benign process. For instance, the reaction can be conducted in the temperature of 100 ^{o}C without both solvent and catalyst. The aldol condensation can also be performed in heterogeneous catalyst. The heterogeneous catalyst can be reused with high selectivity, and this was also valuable benefit of this mechanism.

Some principles of green chemistry have been applied on condensation reactions. The aldol condensation can be carried out with heterogeneous catalyst. The right selection of catalyst is absolutely needed since it is the main step of producing friendly environment results [5]. In this research, heterogeneous catalyst was chosen for the reason of selectivity and reusability, which can minimize insignificant products. Several common heterogeneous catalysts that have been introduced on aldol condensation reactions were hydrotalcite [6], [7] and ZrO_2-montmorillonite [8]. Not only the choice of catalyst, the use of accurate solvent would also be able to minimize environmental problems [9].

The results showed the importance of alternative methods which fitted to green chemistry principles. This research studied two variables of solvent which used water and molar ratio of the reactants which was reduced. The objective of research was to study the effect of those variables to the yield and selectivity.

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II. METHODS

A. Materials

Materials used in this research were cinnamaldehyde, acetone, ethanol, NaOH, commercial hydrotalcite (HTc with the formula of $Mg_6Al_2(OH)_{16}CO_3.4H_2O$), calcined HTc (c-HTc) and several solvents for the Thin layer chromatography analysis.

B. Procedure

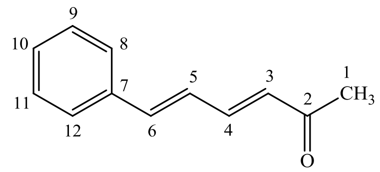
Cinnamalcetone synthesis with molar ratio of cinnamaldehyde:acetone=1:10. Synthesis of cinnamalcetone was started by dissolving 5 mmole of cinnamaldehyde and 50 mmole of acetone in 4mL of ethanol. Into 2mL of 3M solution NaOH was added and was stirred homogeneously within the ice bath to get precipitation. The precipitation was filtered and then washed by 2:1 ethanol:water solvent before it was dried. The filtered solid was then utilized as a reference (1).

Similar procedure was conducted by the addition of HTc and c-HTc to obtain product (2) and (3). Furthermore the cinnamaldehyde:acetone molar ratio and solvent were varied to obtain the other products. Product identification was performed by using thin layer chromatography, FTIR spectrophotometry, and Nuclear Magnetic Resonance Spectrometer.

III. RESULT AND DISCUSSION

Identification of amount, specification and proton position were analyzed by NMR. The prediction of NMR shift was calculated by the computer program of ChemDraw. The results were tabulated in the Table 1.

TABLE 1. COMPARISON OF NMR DATA AND CHEMDRAW PREDICTION



No of C	δH					δC	
	Exp (ppm)	Σ	m	J (Hz)	Chemdraw Estimation	Exp (ppm)	Chemdraw Estimation
1	2.32	3	S	-	2.27	27.5	27.6
2	-	-	-	-	-	198	197.7
3	6.26	1	d	15.52	6.3	130	129.3
4	7.25	1	d	15.52	7.4	143.4	142.1
5	6.57	1	d	15.52	6.7	129	125
6	6.96	1	d	15.52	7.02	141.4	141
7	-	-	-	-	-	136.13	135.2
8	7.47	1	dd	8; 1.3	7.6	127.24	128.5
9	7.28	1	dd	8; 1.3	7.4	128.8	128.6
10	7.48	1	dd	8; 1.3	7.3	126.9	127.9
11	7.28	1	dd	8; 1.3	7.4	128.8	128.6
12	7.47	1	dd	8; 1.3	7.6	127.25	128.5

HNMR spectra shows singlet peak of $CH_3C=O$ at 3.2 ppm region [6]. Proton at H3, H4, H5 and H6 are exhibited by doublet peak with coupling constant *J* of 15.52 Hz from the alkene. Aromatic proton is exhibited by double doblet peak with *J* of 8 Hz for ortho coupling and 1.3 Hz for meta. The position among proton is identified and described by Fig.1 and from all relationships, it is noted that the synthesized product is cinnamalacetone.

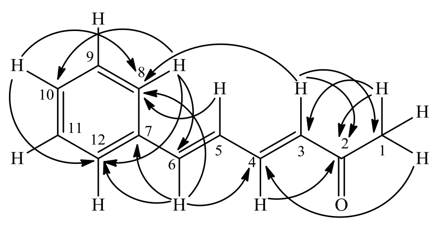


FIGURE 1. HMBC OF SYNTHESIS RESULT

A. Effect of catalyst in the synthesis

Synthesis cinnamalacetone through crossed aldol condensation reaction formed yellow solid powder. Cinnamalacetone synthesis method development using friendly processes were performed by three related methods. The first method was carried out to use HTc and c-HTc as catalysts with NaOH as a control. The second, reduction of reagents was done by changing the mole ratio of cinnamaldehyde:acetone (C:A). The third, method was conducted to reduce the harmful ethanol solvent by distilled water solvent. The results of the three methods were presented in Table 2.

TABLE 2. YIELD OF THE SYNTHESIS

No of product	C:A mole ratio	Catalyst	Solvent	Yield (%)
1	1:10	NaOH	EtOH-H_2O	3.66
2	1:10	NaOH + HTc	EtOH-H_2O	0.97
3	1:10	NaOH + c-HTc	EtOH-H_2O	13.94
4	1:5	NaOH	EtOH-H_2O	5.46
5	1:5	NaOH + HTc	EtOH-H_2O	1.66
6	1:5	NaOH + c-HTc	EtOH-H_2O	14.61
7	1:10	NaOH	H_2O	23.9
8	1:10	NaOH + HTc	H_2O	59.25
9	1:10	NaOH + c-HTc	H_2O	74.22
10	1:5	NaOH	H_2O	24.55
11	1:5	NaOH + HTc	H_2O	43.07
12	1:5	NaOH + c-HTc	H_2O	78.13

Crossed aldol condensation to form cinnamalacetone by sodium hydroxide catalyst had been reported [2]. It was found that the product still has dicinnamalacetone as major product, identified by the absence of proton at 2.3ppm specifically for CH_3CO- in cinnamalcetone. It was supported by previous report that the better product was obtained over the use of HTc catalysts [7].

Utilization of varied HTc from calcination treatment in this work was conducted to evaluate the effect of specific surface area of the catalyst. Theoretically the higher surface area, the higher catalyst activity is. The experimental series are also fit to the theory in which c-HTc produced higher yield compared to those of homogeneous catalyst and HTc. The specific surface area data of the catalysts is listed in Table 3.

TABLE 3. SPECIFIC SURFACE AREA OF HTc AND c-HTc

No.	**Catalyst**	**BET surface area (m^2/g)**
1.	HTc	9.7894
2.	c-HTc	10.3943

Table 3 showed different surface area because of different catalysts. It was mainly due to the structure and basicity of the HTc, and its transformation onto c-HTc [10]. Calcination process will also increase the number of base sites on a hydrotalcite due to the loss of water and ions NO_3 [11] or water and CO_2 [8] along with the increased surface area. The evaporation of water in the calcination process causes more open space so that the aldol condensation reactions more easily occur.

B. Effect of C:A mole ratio

Previous research showed synthesis with C:A ratio of 1:1 produced yield of 1.35% [12]. This was related to the target of cinnamalcetone which have acid properties of Hα which is easily released and interacted with base catalyst to form nucleophil for further reaction. The mechanism is presented by Fig. 2. The mechanism in Fig.2 shows the aldol condensation after cinnamalcetone formation which indicated that C:A (1:1) was not effective to get targeted compound.

Synthesis of benzalacetone with benzaldehyde:acetone (1:32) over HTc catalyst at room temperature gave 6% yield, and furthermore increased to 22% at 0 ^{o}C [8]. However, the selectivity was very poor despite the mole ratio was high. Other synthesis of cinnamaldehyde:acetone over Microwave assisted organic synthesis (MAOS) over molar ratio of 1:1, 1:5, 1:10, 1:15 and 1:20 was reported by Nurcahyo [13]. The result indicated that the ratio of 1:10 and 1:5 gave the highest products. For the reasons of minimum amount chemicals used as principle of green chemistry, this work used lower ratio of 1:5.

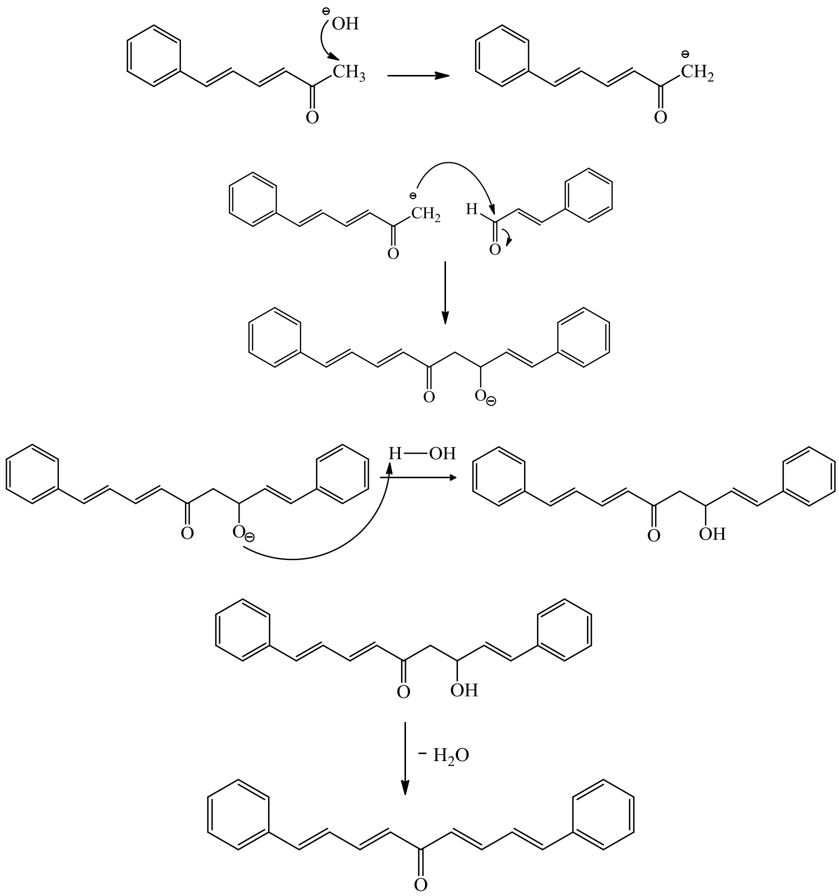


FIGURE 2. B-HYDROXY KETON DEHYDRATION TO CINNAMALDEHYDE

Table 1 expressed that by all solvent and catalyst variation experiments, the C;A ratio of 1:5 experiment produced higher yield than that of 1:10. For example, the yield of **4** over NaOH catalyst was 5.46%, higher than the yield of **1** (3.66%). From the experiments with various conditions, only **8** did give unusual product in which C;A ratio of 1:10 gave higher yield (59.25%) compared to **11** with the ratio of 1:5 (43.07%)

C. Effect of Solvent

Organic reaction was theoretically affected by several reaction parameters such as temperature, mole ratio, time and solvent. From the Table 1, it was concluded that water use as solvent is more effective compared to ethanol:water (1:1). The use of water gave some benefits, such as cheap, non toxic and environmentally safe without any advanced treatment. From the data, it was also found that the combination between HTc catalyst was properly performed with water solvent. However the use of water is still considered as base surface catalyzed reaction that was antagonistically inhibited by water [9].

Calcined HTc gave released-water and CO_2. As a consequence, an exchange of HCO_3 and CO_3^{2-} by OH^- in the interlayer space occurred within the utilization of HTc in catalysis, This hydroxyl ions bonded onto the surface was potential base for the catalysis. This condition was slightly reduced by using uncalcined HTc case, because the exchange did not occur in the case. Even though the synthesis method of the research was not optimal yet since water solvent resulted in side product of β-hydroxyaldehyde or dicinnamaldehyde, the maximum yield of cinnamalcetone in this research was high.

IV. CONCLUSION

From the experiments, it can be concluded that the use of c-HTc in the synthesis give more effective catalysed reaction compared to the use of HTc and NaOH. The maximum yield of cinnamalacetone was performed at 1:5 C:A mole ratio and water utilization is better than ethanol:water as solvent.

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C-18

Enhancement of Wastewater Treatment from Chemical Laboratory Using Subsurface Bubble of Air Generator

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***Abstract*—**Aeration, a unit process in which air and water are brought into intimate contact, is an extremely important step in the process of wastewater treatment. Subsurface aeration is the release of air, in the form of bubbles, within the tank of wastewater to supply the microorganisms with the required amount of oxygen they need to metabolize and break down the organic material suspended in the wastewater. The bubbles of air are released from the bottom of the wastewater tank through diffusers. The feasibility of subsurface aeration process for the enhanced treatment of wastewater from chemical laboratory was investigated through laboratory experiments. In this study, air is generated during treatment process by 5, 10 and 15 L/min. in 1, 3, 5 and 7 h, respectively. The results showed that the BOD and COD concentration increased by the decreasing of DO concentration. In addition, more than 5% TDS is also reduced.

Keywords: *Aeration, BOD, COD, Chemical wastewater, DO, micro-bubble*

I. INTRODUCTION

Aeration is the process whereby the contact area between water and air increases both with natural methods and by a mechanical device, in other words is a method to increase the oxygen in the water. Aeration is one technique that is often used in the improvement of physical and chemical characteristics of the treatment process. In wastewater treatment, aeration process to bring water and air into the medium closest to expose in the form of small size water or air bubbles and let them ride through the water. The efficiency of the aeration process is depending on the amount of surface contact between air and water. This contact is controlled primarily by the size of the drop of water or air bubbles [1].

Aeration tanks have a few of advantages [4]:

- ensure aeration and circulation of the wastewater;
- also is an ideal living conditions for aerobic bacteria;
- aeration influence on flow conditions;
- design of the aeration tank;
- recirculation in the denitrification area and whole aeration tank.

Aeration equipment commonly employed in wastewater treatment is classified into three categories [5]:

- air diffusion units;
- turbine aerations units;
- surface aeration units.

In principles, the air contains 20.95% oxygen. At standard barometric pressure (760 mmHg), the pressure or 'tension' of oxygen in air is 159 mmHg. The pressure of oxygen in air drives oxygen into water until the pressure of oxygen in water is equal to the pressure of oxygen in the atmosphere. When pressures of oxygen in water and atmosphere are equal, net movement of oxygen molecules from atmosphere to water ceases. The water is said to be at equilibrium, or at saturation, with dissolved oxygen (DO) when the oxygen pressure in the water equals the pressure of oxygen in the atmosphere. The DO concentration in water at saturation varies with temperature, salinity, and barometric pressure. As water temperature increases, DO concentration at saturation decreases. At a given temperature, the DO concentration at saturation increases in proportion to increasing barometric pressure. The concentration of DO at saturation decreases with increasing salinity. Water also may contain less DO than expected at saturation. At night, respiration by fish, plants, and other pond organisms causes DO concentrations to decline. Thus, during warm months, night-time DO concentrations in ponds often are below saturation. In production ponds, DO may decrease by 5–10 mg/L at night, and in un-aerated ponds, DO concentrations at sunrise may be less than 2 mg/L [6].

Aeration process has been applied in several studies on wastewater treatment. For example, Primasari *et al* (2011) [2] has applied the method in the oily wastewater from palm oil food industry. Effect of aeration and sludge concentrations were studied by 3 different aeration rates (no aeration, 1.5 L / min and 2 L / min). The water quality was observed using COD, BOD, oil and grease content and pH. Oils and Grease was found decreased in the range of 12.9 to 54.8%, and removal of COD in the range of 85.1 to 97.1%. Also, Boyle (2002) has investigated the effect of aeration by means of leachate quality (COD, BOD) at 4 different aeration rates of 0.1, 0.3, 0.6 and 1.01/min. The results showed that after 75 days of operation, COD reduction was greater than 80% in all of the aerobic reactors and reaching more than 85% at the end of the experiment. Meanwhile, BOD removal efficiency was determined to greater than 95% [3].

In this study aimed to treat the chemical laboratory wastewater using aeration process. Aeration process which fine bubble diffusers type. Fine bubble diffusers is a subsurface from of aeration in which air is introduced in the form of very small bubble [7]. Small bubbles, having a high surface area per unit volume, provide good oxygen-liquid contact, leading to relatively high values of the oxygen transfer efficiency. Diameter of bubbles released from these diffusers are 30 mm, the oxygen transfer efficiency depending on bubble size [5]. The air was exposed into the water through aeration stone from the air pump pressure. The efficiency process was measured by BOD, COD and TDS value.

II. MATERIAL AND METHODS

The wastewater was exposed by a micro bubble air generator (Yasunaga, Japan, power of 29 watt and flow rate of 32 L/min) in 16 L wastewater reactor. The micro bubble air was generated by using an affixed 4 pieces of air diffuser made from a sand stone. Fig. 1 shows a configuration of aeration process.

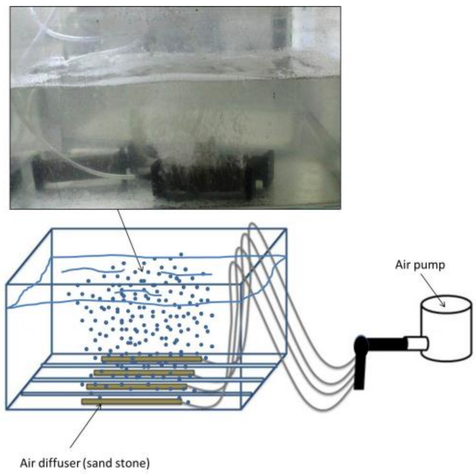

FIGURE 1. WASTEWATER TREATMENT USING MICRO-BUBBLE AERATOR

Wastewater treatment process was conducted by 3 different time air flow (1, 3, 5, 7 h) in flow rate of 5 L/min. The process was evaluated by measurement of COD, BOD, pH, DO, TDS, conductivity, and turbidity, respectively.

III. RESULTS AND DISCUSSION

A. Turbidity and TDS profiles

The initial condition of wastewater was determined prior to aeration process is done. Tables 1, 2 and 3 show the results of wastewater analysis before and after aeration process in term of observed parameter. Table 1 shows that the turbidity increased at the first 5 hour process due to floating mass of dissolve organic components following the aeration from air pumping into the wastewater since it does not undergo precipitation. Contrary results showed that the TDS decreased with the increase of aeration time.

TABEL 1. CHARACTERISTIC OF TURBIDITY AND TDS VALUE AFTER 5 L/MIN AERATION

Parameter	Time (hours)				
	0	1	3	5	7
Turbidity, NTU)	1.69	3.26	2.34	2.07	0.91
TDS, mg/L	372	357	355	350	349

B. DO, BOD and COD profiles

Fig. 2 shows that the dissolved oxygen (DO) decreased with the increase of aeration time due to realizing the oxygen into atmosphere since at time of aeration process using an open reactor system. However, the BOD and COD value increased with the increase the aeration time.

TABEL 2. CHARACTERISTIC OF DO, BOD AND COD VALUE AFTER 5 L/MIN AERATION

Parameter	Time (hours)				
	0	1	3	5	7
DO, mg/L	23	17.3	12.6	5.8	4.9
BOD, mg/L	36	71.6	107	71.6	107
COD, mg/L	92	100	216	115	187

C. pH and Conductivity profiles

Fig. 3 shows the pH and conductivity profiles of the wastewater during 7 h aeration process. Solution pH increased following the decrease of conductivity. pH and conductivity has inversely relationships due to the presence of hydrogen ion concentration used for pH. Conductivity decreased since reducing the presence of ions that capable to deliver an electric current in the solution.

TABEL 3. CHARACTERISTIC OF DO, BOD AND COD VALUE AFTER 5 L/MIN AERATION

Parameter	Time (hours)				
	0	1	3	5	7
pH	7.31	7.64	7.8	8.22	7.9
Conductivity,μS/cm	721	716	709	703	700

IV. CONCLUSION

From this study it can be concluded that the aeration treatment can reduce the TDS value in the wastewater from chemistry laboratory. The aeration process using an open reactor can reduce the DO value since the oxygen released into the open air.

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Phytochemical and Antibacteral Activity Test Of Secondary Metabolite Compound In *Rhizophora mucronata* Methanol Leaves Extracts

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Abstract—The purpose of this research are to phytochemical and antibacterial activity test of secondary metabolite compound in *Rhizophora mucronata* methanol leaf extract that obtained from Lappa village, Samataring District, East Sinjai Regency, South Sulawesi. This research was carried out in several steps, they were maceration, evaporation, phytochemical test and antibacterial activity. Phytochemical testing research results showed that the secondary metabolites contained in *Rhizophora mucronata* methanol leaf extract were flavonoids and steroids compounds. Antibacterial activity testing used *Staphylococcus aureus* and *Escherichia coli* bacterial was done with diameter stage resistor area (DDH) with 10%, 20%, 40%, 60% concentration. This research was conducted at the Laboratory of Chemistry and Biology, Mathematic and Exact Faculty, Makassar State University. The test results showed that diameter stage resistor area of *Rhizophora mucronata* methanol leaf extract in 40% and 60% concentration most effectively inhibit the growth of *S. aureus* and *E. coli* bacterial because it has the IPD > 8 mm.

Keywords: *Phytochemical, Antibacterial, R. mucronata, S. aureus, E. coli.*

I. INTRODUCTION

Development of usage on natural ingredients as a traditional medicine to better use more in demand now. This is happened because traditional medicines are relatively easy to obtain and get supported by their ingredients from nature that grows abundantly in Indonesia. Usage of traditional medicine become more frequent and widespread in society. One of the alternatives that can be used is the active compounds of mangrove. Besides the abundant amount, mangroves have also been widely used as natural medicines. Some mangrove species have been used as a traditional and natural insecticide and pesticide. There are around 112 countries have mangrove and most of the area between 30^0 north and south of the equator and divided into 8 families and consists of 12 genera of flowering plants: *Avicennie, Sonneratia, Rhyzophora, Bruguiera, Ceriops, Xylocarpus, Lummitzera, Laguncularia, Aegiceras, Aegiatilis, Snaeda*, and *Conocarpus* [8].

Rhizophora mucronata is one mangrove species that has antibacterial, antiviral and antifungal functions. An antibacterial substance that can inhibit or kill the bacterium causing the infection. Infections caused by bacteria or pathogenic microorganisms, which the microbes get into the body tissues and proliferate in the body networking. Among the bacteria that can cause infections are *Staphylococcus aureus* and *Escherica coli*. *Staphylococcus aureus* can cause pneumonia, meningitis, empyema, endocarditis or sepsis with suppuration in each organ [5].

Research on the antibacterial activity of *Rhizophora mucronata* extracts and content of secondary metabolites ever done. In its phytochemicals have several kinds of compounds such as tannins, alkaloids, flavonoids, terpenoids and sapponins [3] [6] [13].

Based on research conducted said that *R. mucronata* bark extract has antimicrobial properties against *Escherichia coli, Salmonella typhi, Staphylococcus aureus,* and *Pseudomonas aeruginosa* whereas stems of *Rhizophora apiculata* extract has antibacterial and antifungal properties against

Candida albicans. Another study conducted said that mangrove leaves extracts have antibacterial properties against *Escherichia coli* and antifungal against *Penicillium digitatum* [3] [12].

Based on the foregoing, we intends to continue the research to determine the phytochemical content and antibacterial activity of mangroves *R.* leaves extract.

II. RESEARCH METHODS

This research is an experimental study that includes sample preparation, extraction (maceration), evaporation, phytochemical test and antibacterial activity test which conducted at the Chemistry and Biology Laboratory, State University of Makassar. Research was conducted in September 2014-January 2015.

The tools used in this research are laboratory glassware, analytical balance, oven, blender, maceration vessel, rotary evaporator, needle ose, Buchner funnel, petri dish, a hot plate, a magnetic stirrer and water bath.

The materials used in this study are *R. mucronata* leaves, methanol, Whatmann filter paper, *Staphylococcus aureus, Escherichia coli* bacteria, 96% ethanol, paper disc, a petri dish, Nutrient Agar (NA), aluminum foil, paper filter , tissue, distilled water, napkins and alcohol 70%.

A. Sample Preparation

R. mucronata leaves samples taken from Lappa Village, Samataring District, East Sinjai Regency, South Sulawesi. *R. mucronata* leaves sampled are still fresh leaves which cleaned and washed and then dried with aerated.

B. Sample Extraction

The process of extraction were done using maceration techniques. A total of 500 grams of dry leaves of *R. mucronata* macerated with methanol during 2x24 hours. The extract was concentrated using a rotary evaporator to obtain. This extract was used for testing in phytochemicals and antibacterial effectiveness.

C. Test Phytochemicals

Methanol extracts of *R. mucronata* leaves analyzed to identify the type of secondary metabolites contained in the sample. The reagents used include $FeCl_3$ (phenolic test), Liebermann-Burchard (steroids and terpenoids test), Mayer (alkaloids test), and Wagner (alkaloids test).

D. Antibacterial Activity Test

The initial step in testing the bacteria sterilization of tools and media using the autoclave was set up at a temperature of 121^0C at a pressure of 15 psi (per square inch). *R. mucronata* extracts for antibacterial testing was done by measuring the Inhibitory Power Diameter (IPD) on the growth of *Staphylococcus aureus* and *Escherichia coli*.

The method was done by measuring the diameter of the clear zone around the paper disk antibacterial activity. Inhibitory zone diameters obtained were then compared to the negative control inhibition zone (distilled water).

IPD methods performed using filter paper circle that has been soaked in the sample for 1 hour, placed on the medium in a petri dish that has been inoculated with microorganism test. The measured parameter was the area resistor were clear zone formed around the paper disc after incubated for 2x24 hours at a temperature of 37^0C. Inhibitory zone diameters measured in millimeters (mm) using calipers by way of reduced overall diameter paper disc diameter of 6 mm. In this study, *R. mucronata* leaf extract with used 10%, 20%, 40%, 60% concentrations and sterile distilled water was used as a negative dick.

III. RESULTS AND DISCUSSION

This research used methanol to extract the metabolites in a sample. Where, methanol is able to penetrate the cell wall on the sample so that compounds that are polar and non-polar can be extracted in methanol.

Results of research have shown that the methanol extract of *R. mucronata* leaves positive for some type of secondary metabolites compounds. The reagen tested can be seen in Table 1.

Table 1 Result of Colour Tested To *R. mucronata* leaves Methanol Extaract

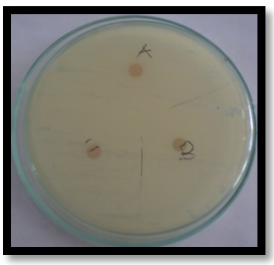
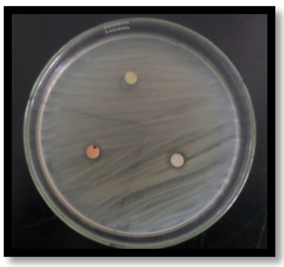
Regen- Tested	Colour	Output
$FeCl_3$	Green → brownish green	(+) Flavonoids
Liebermann-Burchard	Green → clear green	(+) Steroids
Mayer	Green → green	(-) Alkaloids
Wagner	Green → brown	(-) Alkaloids

Test results obtained showed that the extract were flavonoid compounds group. It is shown from the positive reaction between two reactants isolates with iron (III) chloride ($FeCl_3$) 1% which indicated by a color change from green to brownish green.

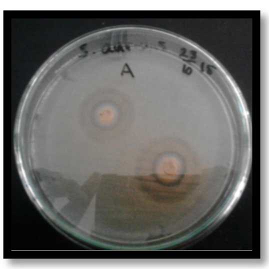
Identification also showed a steroid compounds in extracts of *R. mucronata* with technical analysis phytochemical that is characterized by the formation of green color after being given test with Liebermann-Buchard reagents. Identification of the alkaloid in the plant extract made with two reagents phytochemical test, i.e. Mayer and Wagner reagents. At Mayer reagent characterized by the formation of a white precipitate, while Wagner reagent characterized by the formation of brown to yellow. In phytochemical test of *R. mucronata* leaves extracts does not contain alkaloid compounds, results showed no white formation deposits on the Mayer reagent deposition and brown to yellow on Wagner reagents.

Based on testing that has been done can be seen that the *R. mucronata* methanol extract positive for some type of secondary metabolites, i.e steroids and flavonoids. *R. mucronata* extracts for antibacterial testing was done by measuring Inhibitory Power Diameter (IPD) on the growth of *Staphylococcus aureus* and *Escherichia coli*. The method was done by measuring the diameter of the clear zone around the paper disk antibacterial activity. Clear zone is an indication of the bacteria sensitivity to antibiotics or other antibacterial material that was used as the test material which is expressed with a width of inhibition zone diameter. Inhibitory zone diameters measured in millimeters (mm) using calipers by way of reduced overall diameter paper disc of 8 mm diameter. Then the diameter of inhibition zone is categorized as anti-bacterial power classification [2].

In this study, the concentration of *R. mucronata* methanol extract used are 10%, 20%, 40%, 60% concentrations and sterile distilled water was used as a negative dick. Antibacterial effectiveness test results are presented in Figure 1 below.

10 % and 20 % concentration with positive control




S. aureus 40% and 60% concentration   *E. Coli* 40% and 60% concentration

Figure 1. IPD *R. mucronata* extract against *S. aureus* and *E. coli*

Based on the test results of *S. aureus* and *E. coli* against activity, obtained extensive IPD for *S. aureus* at 60% concentrations amounting to 15.12 mm (strong), 40% concentrations amounting to 8.63 mm (medium), 20% concentrations with 1, 33 mm (less), containing 10% concentrations with 0.87 mm. While the bacteria *E. coli*, obtained extensive IPD to 60% concentration with 13.42 mm (strong), 40% concentrations was 6.26 mm (medium), 20% concentrations with 0.91mm (less), containing 10% concentrations with 0.61 mm and positive control (distilled water) with 0 mm.

Based on these results, it can be seen that the concentration of *R. mucronata* leaves methanol extract which has the greatest inhibition was at 60% concentration with area was 15.12 mm clear zone on *S. aureus* and 13.42 mm in *E. coli* bacteria.

According [2], antibacterial strength criteria as follows: inhibition zone diameter of 5 mm or less categorized as weak, 5-10 mm zone of inhibition is average, 10-20 categorized strong inhibition zone, and the zone of inhibition of 20 mm or more categorized as very strong. The establishment of clear zone around the paper disc shows the inhibition of the growth of bacterial colonies due to the influence of bioactive compounds contained in n-hexane extract of leaves of the soursop.

At 40% and 60% concentration formed wide clear zone indicating that there has been inhibition of bacterial growth while at 10% and 20% concentration less formed clear zone indicating that the lack of inhibition of bacterial growth on both bacteria represent gram-positive and negative. The inhibition of bacterial growth is due to secondary metabolites class of flavonoids and steroids that are bioactive at a 40% and 60% concentration, whereas the concentration of 10% and 20% also contain secondary metabolites class of flavonoids and steroids but the number of compounds in the extract concentration was slightly, so it can't to inhibit the growth of bacterial colonies.

The inhibition of the growth of bacterial colonies suspected to be caused due and damage on the structural components of bakteri cell membranes. Other research result suggests that cell membranes are composed of proteins and lipids which particularly vulnerable to chemicals and can reduce the surface tension. Damage to the cell membrane causing disruption of nutrients transport (compounds and ions) through the cell membrane, so that the bacterial cells deprived of nutrients needed for growth.

VI. CONCLUSION

From the research that has been done can be concluded that *R. mucronata* leaves methanol extract positive for some type of secondary metabolite compounds, i.e. steroids and flavonoids compounds. And the antibacterial activity test results with Inhibitory Power Diameter (IPD) measuring showed that a strong antibacterial activity against *S. aureus* and *E. coli* with 60% concentration is due to have a value of IPD > 11 mm and being category for 40% concentration. At the time of the test inhibitory antibacterial activity of *R. mucronata* extract begin to look at 10% to 20% concentration with no sightings in media and there was less clear zone category. The ability occurs because of the role of the chemical compounds in extracts of *R. mucronata* extract of flavonoids and steroids compounds.

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C-20

Review of the Molecularly Imprinted Hydrogel In Chemical Analysis

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***Abstract* –** The Molecularly Imprinted Hydrogel (MIH) is an insoluble polymer that the cavity has identical chemistry shape to the molecule target. This hydrogel is one of the Molecularly Imprinted Polymer (MIP) type commonly used in water solution. MIH is recently developed for chemical analysis needs. The MIH can give best analysis result. The analysis process should be aimed to get high accuracy and reproducibility in order to show the reliable result. It can be achieved by ensuring the supported instrument had similar character to the target molecule. The character is made by using the target molecule as an imprint in the polymer synthesis. After the extraction target molecule step, it will leave the identical cavity used to trap target molecule in the sample. The advantage of using MIH is the good result of external stimuli, such as pH, temperature, ionic strength, or electric field. Moreover, MIH can be used in various field. In pharmacy, MIH is used as carriers of drugs, proteins and glucose analysis which also show the stimuli-responsive behavior for its recognitions. Additionally, MIH is also used as separation media in particular direction such as food samples.

Keywords: *molecularly imprinted hydrogel (MIH), polymer, chemical analysis*

I. INTRODUCTION

Polymer is defined as the substance that consists of molecules with one or more monomer units. A polymer is a repeating chain of atoms, formed from a binder in the form of identical molecules called monomers. Though usually an organic molecule (having a carbon chain), there are also many inorganic polymers.

The use of polymers in the field of chemical analysis has been carried out. One of the goals in synthesizing polymer for this purpose is to provide material analysis support that can improve the quality of analytical results of accuracy, sensitively and reproducibility. Polymer modification to support chemical analysis can be done via imprinting techniques of molecule, common namely with Molecularly Imprinting Polymer (MIP).

MIP is a polymer synthesis techniques using analyte molecules as its template. The molecule imprinting process in the polymer particles is generally carried out simultaneously with the process of monomer polymerization. Thereafter, the analyte molecules are extracted from the body of the molecule, so that part was originally imprinted the molecule into empty space with an identical shape to the imprinter molecules [1]. In the process of chemical analysis, e.g. for pretreatment separation, identical cavities can be used to trap molecules of the same/complement characters. This basic principle is also developed for polymers which have the character of swelling, such as the hydrogel.

Printing molecules in hydrogel particles formed MIH is a new technique in the synthesis of MIP, which is very likely to grow rapidly. With the basic character of hydrogel is insoluble in water, the hydrogel can well interact in aqueous solvent systems. MIH which is considered safer in substance, the use of hydrogel polymer will not leave residue. In general, that usable imprinting hydrogel is already related in the polymer hydrogel body and have the same character with the hydrogel as a whole. Therefore, it is necessary to study the basic character of imprinting hydrogel, synthesis techniques and a variety of possible applications in chemical analysis.

II. THE HYDROGEL

Hydrogel is a polymer network that has the ability to swell in water. A hydrophilic gel that is often considered a hydrogel is a network of polymer chains that was found as a colloidal gel in which water acts as a dispersing medium. Researchers commonly define hydrogel as a substance that expands in water, have a crosslinking bond in the polymeric networks produced from the simple reaction of one or more monomers. Another definition states that polymeric materials have the ability to inflate and hold significant amounts of water in the structure, but insoluble in water. Hydrogel may be considered its usefulness performance in last 50 years based on their ability promising in various fields. Hydrogels also have a degree of flexibility that is similar to the body's tissue which also contains a lot of water [2].

The ability to absorb water in the hydrogel is derived from hydrophilic functional groups attached to the polymer backbone. As for why the water-insoluble hydrogel derived from crosslinking bonds between the polymer chains within the network. Many materials, both natural and synthetic polymer have the same definition with hydrogel.

III. HYDROGEL CLASSIFICATION

Hydrogel is classified in several groups. That is based on the origin, the composition of the polymer, the configuration of the structure, the type of cross-linker networks, the physical nature, and its electrical charges network. The origin of hydrogel consists of natural and artificial hydrogel. Additionally, the composition of the polymer is actually influenced by the method of preparation, so hydrogel is grouped into hydrogel homo-polymer, copolymer hydrogel and hydrogel multi-polymer. Homo-polymer hydrogel is a network polymer derived from a monomer having basic structure consisting of any polymer network. Homo-polymers may have crosslinking at the chain structure depend mainly on the basic character of the polymer and polymerization techniques. Hydrogel copolymers consisted of two or more different species of monomer with at least one hydrophilic component, composed of random, block or alternate configuration along the polymer chain. Multi-polymer Interpenetrating Polymeric Hydrogel (IPN), one type of important hydrogel, is made of two independent synthetic crosslinking or polymers in the form of a network.

Based on the configuration of physical structure and chemical compositions, hydrogel is classified into an amorphous (non-crystalline), semi-crystalline (a complex mixture of amorphous and crystalline phases), and crystalline. While from the type of cross-linking bond, hydrogel is divided into the origin of the intersection of physical, or chemical crosslinking. Chemical crosslinking network has a permanent junction, although a network of physics intersections has a well-formed polymer chain involved or of physical interaction such as ionic interactions, hydrogen bonding or hydrophobic interactions. Furthermore, based on their physical appearance, hydrogen recognized as a matrix, thin layer films or microspheres depending on the polymerization technique used in the preparation stage.

Other classification is based on electric charge network, hydrogel is divided into four categories based on the presence or absence of electrical charge that is located on a chain crosslinking non-ionic (neutral), ionic (including anion or cation), electrolyte amphoteric (ampholytic) contain both acid groups and base, or zwitter-ion, ion containing both anionic and cationic groups at each repeat unit structure [3].

IV. HYDROGEL AND IMPRINTED HYDROGEL POLYMERIZATION TECHNIQUES

Hydrogels have adequate network crosslinking polymers with three dimensional hydrophilic bonding to constrict reversibly expands in water and leaving a large volume of fluid in the form of deployment. Hydrogel can be designed with a response that can be controlled to shrink and swell with changes in the external environment. Hydrogel can show the dramatics volume in transition response to various stimuli physics and chemistry where physical stimuli are temperature, electric charge or magnetism, light, pressure, and sound while chemical stimuli include pH, solvent composition, ionic strength and the molecular species.

Further expand or shrink response to change in the external environment can be very drastic for hydrogel as a known phenomenon which is called volume collapse or transition phase. Generally, three main parts in the synthesis of hydrogel is the monomer, initiator and cross-linker. To control the heat of polymerization reaction, and the final properties of hydrogel, solvent can use, for example, water, or other aqueous solutions. Then, the hydrogel mass is washed to clean impurities or residual constituents.

Synthesis hydrogel using acrylamide, acrylic acid or salt thereof by suspense and dissolution polymerization were more choosen. Hydrogel is generally made from polar monomer. Based on the basic material, hydrogel polymer can be classified as natural, synthetic polymer hydrogel and a combination of both types. Based on the preparation method, hydrogel can be obtained by graft polymerization, cross-linking polymerization, formation of a water-soluble polymer, and the formation of crosslinking by radiation. Polymerization techniques used are bulk polymerization, solution polymerization, suspension polymerization, polymerization with grafting technique/ coating, and radiation polymerization [2].

Most vinyl monomers potential to be synthesized as a hydrogel. Bulk hydrogels can be formed with one or more types of monomers. There are a wide variety of vinyl monomers to prepare a hydrogel with the desired physical properties. A small amount of crosslinking agent need to be added in the right formula. The polymerization reaction is generally initiated by radiation, ultraviolet light or chemical catalyst. Selection of the appropriate initiator based on the considerations in monomer and solvent used. The resulting hydrogel can be a membrane, rod, granular particles and emulsified. Bulk polymerization technique is a way of easiest hydrogel synthesis. The result is a homogeneous hydrogel, clear like glass, has a transparent matrix and very hard texture. However, when immersed in water, the glassy matrix swell to become soft and flexible [4].

In solution polymerization, or known as cross-linking polymerization, the solvent served as a hot reducer becomes a major advantages of the synthesis technique compared to bulk polymerization. Certain solvents used for the hydrogel polymerization such as water, ethanol, a mixture of water-ethanol and benzyl alcohol. Suspension polymerization or dispersion polymerization has its own advantages because the resulted particle are shaped in beads, so it does not require grinding step.

Generally, the hydrogel from bulk polymerization techniques have an inherent weak structure. To improve mechanical properties, a mixture essentially can be deposited on a surface area supporting more robust / stable. So it can be said directly over the polymerization process that supported solids with generally covalent bonded have interaction between polymers and surfaces.

The last of hydrogel polymerization techniques is irradiation with high energy. Gamma rays and electron beams are used as initiator. The irradiation charged on aqueous polymer solution produce radicals on the polymeric chains. The combination of radicals from different chain will form a cross-linking structure in the polymer network.

Reviewing of the hydrogel polymerization techniques, it can be built the imprinting polymer that the molecule template must become a member of supporting polymer pore along polymerization process. From all of polymerization techniques, the template molecule should be added initially together with the monomer, initiator/catalyst, and cross-linker agent. After the imprinted polymer has been resulted, the template directly extracted from the polymer networks. Thereafter, the complement pore that have identical shape with the template molecule are established. After all, the final polymer are known as molecularly imprinted hydrogel (MIH).

Synthesizing the imprinting molecules into organic polymer is first reported by Wulff and Sarhan (1972 in [4]), which recently become a technique widely used in the preparation of polymeric materials with molecular recognition side. The material is applied as a separation media, the sensor element and the catalyst. Step through molecular imprinting techniques polymerization is overcoming between monomers and the molecular imprinter (templates). Complex formation spontaneously happen with a porogenic solvent which sterically set during cross-linking polymerization. The density of crosslinking is determined by the number/amount of crosslinking agent (stoichiometry). After releasing of imprinter molecules from the polymer matrix, artificial identifier will be formed. The template-monomer complex can be formed either by covalent or weak non-covalent interactions (e.g. hydrophobic interaction, ionic and hydrogen bonding [4].

The type of polymerization is selected in addition to the main predictions result considered a functional monomer selection. For example, polymerization of monomer polyvinyl alcohol can be determined in the form of addition polymerization, Vinyl alcohol has a bond that will form a series of polymers with the aid of crosslinking agents and an intermediate form of radical anion or cation. The results of the polymerization will not contain side products, besides the remaining of excess solvent. Cationic addition polymerization is initiated by the acid added to the compound of the double bond to form a cation. These cations play a role in the propagation stage to form a polymeric chain. The acid used is phosphoric acid or sulfuric acid as a catalyst / initiator. MIH can be prepared in various ways for this type of selected polymerization. It can be bulk polymerization (bulk polymerization) or suspension polymerization (suspension polymerization) [5].

Each method has its advantages and limitations. Bulk polymerization method has an advantage in terms of the simplest polymerization technique, does not require special skills and special instrumentation. However, the limited ability of bulk polymerization in terms of the product is not uniform in size, which automatically requires a stage pulverization and particle size selection for specific needs (such as column chromatography material). Furthermore, bulk polymerization also has low performance. Suspension polymerization is more likely done to overcome the polymer particle size uniformity. The resulting particles has spherical granules, high reproducibility, and can be produced on a large scale [6].

V. APPLICATION OF MOLECULARLY IMPRINTED HYDROGEL

Hydrogel, a water insoluble material, has a crosslinking polymer network consisting of homo or hetero hydrophilic polymer, which has ability to absorb significant amounts of water. From the biological point of view, these properties are important because this character is very similar with natural tissue that minimizes possible irritation of the membranes or tissues nearby. Based on this reason, the imprinting hydrogel is widely used in pharmaceutical field, such as delivery agent of various drugs, peptides or proteins.

Recently, most of the gel that sensitive to analyte is not completely synthetic, but it is used the proteins in a polymer matrix as a sensor or activating mechanism. The use of a protein, lectin and other component were incorporated into immunogenic targets along the gel during the synthesis process procedures for the good analyte identification system, which is actually similar, and has a specific cluster included to bind the analyte and demonstrated cross-reactivity to bind the other similar analyte. In other words, it is showing immunogenicity at a higher level. In this section, molecular imprinting bridging it, and so it produces architectural chemical precision that can bind the analyte and distinguish isomers [2].

The design of molecularly imprinted hydrogel for controlled release of cisplatin has been studied [7]. The cisplatin, a widely used metal-based antineoplastic drug that able to have therapeutic activity against several solid tumors along with testicular cancer, ovarian cancer, lymphoma and glioma, becomes the template molecule that together with methacrylic acid (MAAc), 2-hydroxyethylmetacrylate (HEMA) as based hydrogel and NN'-metylenebisacrylamide (NN-MBA) as cross-linker, develops MIP hydrogels. The schematic reaction is shown below.

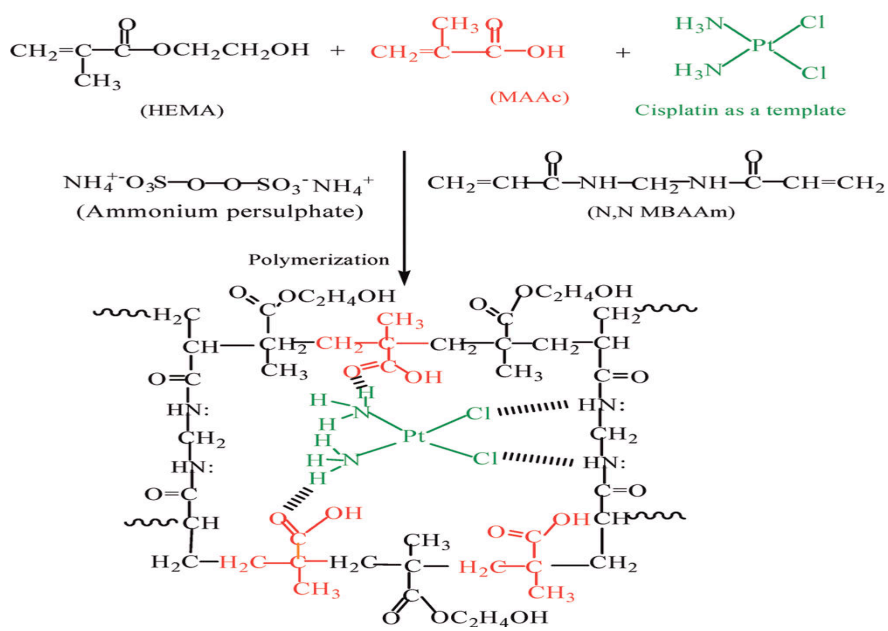

Figure 1. The formation of MIH with cisplatin as a template [7]

Both molecular imprinted and non-imprinted polymers that were synthesized has been used to study the swelling character and the in vitro dynamics release of drug. This hydrogels product is hoped for tumor therapy through slow release of cisplatin with the specified time according to the particular dosage. The research results showed that the swelling parameter was reduced by increasing amount of NN-MBA. Both in the MIH and NIH (non-imprinted hydrogel) in terms of releasing the drug will be lower with the higher NN - MBA because crosslinking density is higher and smaller particle size. Because of its supramolecular interactions, MIP can be used for the development of biomimic drug delivery devices. Of course this should be supported by the application of this MIH-cisplatin in vivo environments.

Other hydrogel imprinting products in pharmaceutical development as drug delivery device is the synthesis of molecularly imprinted stimuli-reponsive hydrogel for protein recognition [8]. By using acrylamide based hydrogel via in situ photo-initiated crosslinking polymerization, MAAc and NN-MBA were synthesized with lysozyme as a template to produce MIH protein recognition. The results showed that MIH was higher than NIH in terms of protein binding capacity and selectivity towards lysozyme and the temperature-responsive swelling-deswelling of the materials modulated the binding ability. The introduction of proteins and signal transduction can be combined in one material for selective protein to MIP hydrogel. This also leads to deswelling ability. Reached such great effects made possible by the combination of hydrogel imprinting matrix. It showed the critical phase transition. Responding to the protein recognition / binding, this result will allow to the additional functions of the hydrogel, for example the development of protein (micro) sensor based measurement swelling and pressure.

Furthermore, the new release of MIH that display isomerically resolved glucose is also proposed by combining poly(allylamine hydrochloride)(PAA-HCL) with glucose phosphate mono-sodium salt binding [9]. This hydrogel is synthesize in order to provide biosensor quantitatively glucose in monitoring diabetic blood. In this study, epichlorohydrin (EPI), ethylene glycol diglycidyl ether (EDGE) and glycerol diglycidyl ether (GDE) were used as cross-linker. The last three of cross-linker has their own type of crosslinking type within polymer networks. Researcher sure that there are relation between polymer binding capacity to the analyte and the cross-linking amount in the polymeric network. And so, these crosslinking models are shown in figure 2.

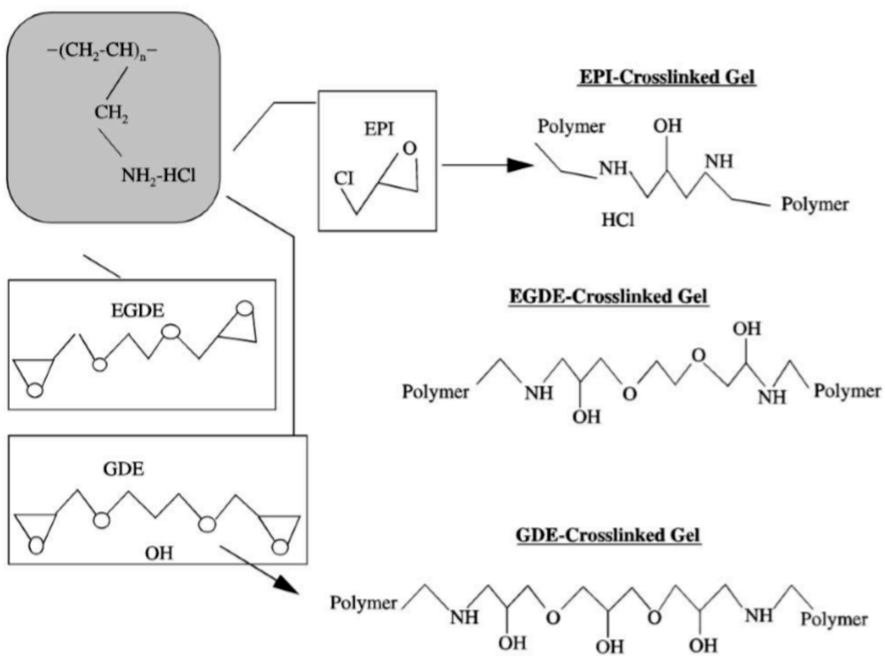

Figure 2. The crosslinking reaction and cross-linker used in MIH synthesis [9]

The results showed that MIH using EPI decrease the glucose binding capacity as increasing the amount of imprint. As the smaller crosslinking than EDGE, it could be expected that EDGE will give quite the same data. But the EDGE data showed that the binding capacity has linier pattern to the increasing of imprint present. Others, the GDE gives different result. The trend observed that as the concentration of imprint increase, both the glucose and fructose binding capacity decrease. But the mechanical integrity of using GDE was very poor when compared to the used of EPI and EDGE. Approximately 25% of each polymer was lost because it has excessive fracture, giving the hydrogel was so inconsistency. So much efforts to be made of optimizing the MIH capability and the factors that affect its properties. The next step is to make MIH-fructose in enhancing the bonding capacity and selectivity for recognition alike glucose hydrogel.

Beside the pharmaceutical applications, the MIH is also used in the food field research. One of this application is the use of Caffeine molecularly imprinted poly(vinyl alcohol) hydrogel in selectivity study to separate contained caffeine in some commodity. It is developed by using polyvinyl alcohol as the monomer, glutaraldehyde as cross-linker and sulphuric acid as the catalyst. This hydrogel is made for environmental reason due to the last caffeine imprinted polymer has the toxic monomer. So it was very worry to apply the hydrogel in the food samples [10]. This recently hydrogel produce in membrane separation by reacting of monomer and cross-linker in the gaseous state to decrease poisonous potency from its nature. The result indicated that the imprinted hydrogel was successful made. The caffeine imprinted hydrogel absorbs a higher amount of caffeine than non-imprinted ones. The hydrogel was in the membrane form, with transparent, homogenous and have good resistance to solvent action, owing to crosslinking.

VI. CONCLUSION

Molecularly imprinted hydrogel can be synthesized with availability of the monomer, cross-linker and initiator/catalyst via several polymerization techniques. Most of synthesized hydrogel give the good result in pharmaceutical field as drug delivery and also in protein and glucose recognitions. The imprinted hydrogel is also used in food samples as caffeine media separation.

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CE – 01

INCREASING EFFECTIVENESS OF NUMBER HEAD TOGETHER (NHT) MODEL THROUGH INTEGRATION OF MULTIPLE INTELLIGENCES THEORY IN CHEMISTRY LESSON

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Abstract. *This study aimed to improve the effectiveness of cooperative learning model which tends to be conventional as Number Head Together (NHT), through the integration of Multiple Intelligences (MI) theory in the syntax. The study was conducted by using a quasy experimental design. Experimental group used NHT-based on MI model , while control group used NHT model. The data of students' achievement were analyzed by t test, while the data of students' multiple intelligences, especially interpersonal intelligence, were analyzed by using chi-square. The results showed that integration of Multiple Intelligences theory in chemistry lesson improves the effectiveness of NHT model, with the following indicators. (1)) Compared to the control group, interpersonal intelligence of students in experimental group develops better. Students' interpersonal intelligence in experimental group increased by 25%. (2) Students in experimental group reach higher achievement. Students' achievement increased by 48.63%.*

Key words: Multiple Intelligences, Interpersonal intelligence, NHT model, chemistry.

I. INTRODUCTION

Many people assume that the IQ (intelligence quotient) is a decisive factor in the success of learning and someone's life (Suparno, 2004). The results showed that in reality the statement is not always true. The study conducted by Hidayani in SMK Ardjuna 1 Malang 2007) found a significant relationship between emotional quotient (EQ) as well as spiritual quotient (SQ) and student achievement. Thus, it was realized that although very important, IQ is not everything . Other factors such as emotional quotient (EQ) and spiritual quotient (SQ) also have an important role in determining a someone's success.

According to Gardner (1983), IQ measurement only emphasize logical-mathematical and linguistic intelligences, whereas it is found that at least eight intelligences exists in every person, namely (1) verbal linguistic, (2) mathematical logic, (3) visual spatial, (4) musical, (5) kinesthetic (6) interpersonal, (7) intrapersonal, and (8)naturalistic.

Moreover, the teaching system in schools just put intelligence models that emphasize mathematical logic and linguistic. Teachers teach with a rational approach applying logical-mathematical intelligence, and explain all the lesson materials with the lecture method that is more relevance with linguistic intelligence. Consequently, it will benefit students who have a dominant logical-mathematical intelligence and linguistics, but it does not help students who have other dominant intelligences.Whereas, according to Gardner (1983), students need to be helped to develop all of their multiple intelligences -not only logiical mathematical and linguistic- by integrating multiple intelligences theory in learning process.

Lwin (2008) stated that one kind of intelligences that plays an important role in the someone's success is interpersonal intelligence. A person who has interpersonal intelligence usually easy to adapt, success in work, and have a good emotion. In one study, researchers of the Harvard Business Review found that the winner of the best achievements in the AT & T Bell Labs, a community of smart engineers in New Jersey, not the one who has the highest IQ, but the one who collaborate easily with others, and popular among his/her friends. Then, in a study conducted on a number of Fortune 500 companies by scientists behaviorists Morgan McCall and Michael Lombardo disclosed that, the most important factor in determining the success or failure of an executive is the ability to connect, understand and cooperate with others. Actually, 80 percent of those who fail in the workplace, due to poor social skills (Lwin, 2008). Therefore, learning process should also be directed to improve interpersonal intelligence.

Learning model that supports the development of interpersonal intelligence is cooperative learning. Cooperative learning is very conducive to develop interpersonal intelligence because it can develop relationships among students of different ethnic backgrounds and different religions, and between students who are academically fall behind their classmates (Slavin, 2008) .

This model can also be applied to all types of classes such as special classes for gifted children, special education classes, classes with an average level of intelligence , and is indispensable in heterogeneous classes with different levels of ability. Besides, cooperative learning can also be applied to a variety of subjects such as math, language, social studies, biology, physics, and chemistry.

Cooperative learning applied to chemistry lesson is intended not only to develop interpersonal intelligence, but also to solve the classic problem in chemistry learning, such as the lack of students understanding due to the characteristics of chemistry concepts. Concepts in chemistry consist of macroscopic, microscopic and symbolic level concept. To understand the chemistry concepts well students must understand the aspect of macroscopic, microscopic and symbolic level of the concept.

In addition to improve learning outcomes, in line with Gardner's theory of multiple intelligences, learning chemistry should also be a medium to improve students' intelligence. In this study, Number Head Together (NHT) was selected as a learning model that is expected not only to improve students' learning outcomes, but also develop students intelligence, especially interpersonal intelligence .

NHT learning model is part of a cooperative model. This model is the kind of cooperative learning designed to affect the pattern of student interaction, as well as to involve more students in studying the subject matter and check their understanding of the lesson material (Trianto, 2009). The syntax of NHT model is quite simple. Integration MI theory in the syntax of NHT model is intended to improve the effectiveness of NHT model.

So far, research on the development of NHT learning model to improve student learning outcomes have often conducted, but the research that is specifically study the development of multiple intelligences has not been conducted yet. Based on the research in eleventh grade of Junior high school students in Balikpapan conducted by Handayani (2007), it was reported that by using cooperative learning, students multiple intelligences can be increased. NHT learning model has also been implemented by Wijayati (2008) and Adriyani (2010) in chemistry and the researches found that implementation of NHT model was able to improve students' learning outcomes. Based on the background and the preview researches, this study investigated the effect of integration Multiple Intelligences theory on NHT learning model toward the development of interpersonal intelligence and learning outcomes of students on chemistry.

II. METHODS

The method used in this study was a quasi-experimental design by applying nonequivalent pretest-posttest control group design. Control group consisted of 33 students and experimental group consisted of 32 students of MAN 2 Banjarmasin South Kalimantan. Experimental group conducted chemistry lesson by integrating MI theory in NHT model, while control group learnt chemistry by applying NHT model without integrating MI theory. The sample was selected by using cluster random sampling technique. The data was taken by multiple intelligence test developed by Armstrong (2004), and McLelland & County (2008) and achievement test. Salt hydrolysis was the lesson material being taught in this study. The differences of multiple intelligences data of both groups were tested using chi-square, while the difference of students' achievement on chemistry was tested using the independent t-test.

III. RESULTS

The Development of Multiple Intelligences

The development of students' multiple intelligences before and after learning can be seen on Table 1 as follows.

Table 1. Students Intelligences Before and After Learning

Intelligences	Control Group				Experimental Group			
	Number		%		Number		%	
	Before	After.	Before	After.	Before	After	Before	After
Lingustic	12	12	36,4	36,4	19	21	59,4	65,6
Mathematic-logical	10	10	30,3	30,3	3	4	9,4	12,5
Musical	20	20	60,6	60,6	14	21	43,8	65,6
Visual spatial	1	1	3,0	3,0	8	12	25	37,5
Kinesthetic	27	26	81,8	78,8	25	25	78,1	78,1
Interpersonal	26	26	78,8	78,8	12	12	37,5	37,5
Intrapersonal	32	32	97,0	97,0	30	30	93,8	93,8
Naturalistic	20	20	60,6	60,6	17	24	53,1	75,0

The development of multiple intelligences is also followed by the development of students' dominant intelligence in some types of multiple intelligences. The distribution of the dominant intelligence of students can be seen in Table 2 below.

Tabel 2. The Distribution of Students' Dominant Intelligences
in Control and Experimental Groups

No	**Intelligences**	**Before**				**After**			
		Control		**Experiment**		**Control**		**Experiment**	
		∑	**%**	∑	**%**	∑	**%**	∑	**%**
1	Linguistic	0	0	0	0	0	0	1	3,125
2	Matematic	1	3,03	1	3,125	1	3,03	1	3,125
3	Musical	4	12,12	1	3,125	2	6,06	3	9,375
4	Visual-spatial	0	0	3	9,75	0	0	2	6,25
5	Kinesthetic	2	6,06	6	18,75	3	9,09	6	18,75
6	Interpersonal	**5**	**15,15**	**2**	**6,25**	**10**	**30,3**	**10**	**31,25**
7	Intrapersonal	17	51,52	15	46,875	16	48,48	8	25
8	Naturalistic	4	12,12	4	12,5	1	3,03	1	3,125

Table 2 shows that the intelligences of control group develop around 15,15%, while in experimental group, students' intelligences improve around 25%. Based on the result of normality and homogeneity test of the data it can be concluded that students' multiple intelligences data were homogeny but not normally distributed. Therefore, the differences of both groups were tested by chi-square.

Table 3. The Result of Chi-square Test of

Experimental and Control Groups

	EXPERIMENT	**CONTROL**
Chi-Square	14.500[a]	18.121[b]
df	5	6
Asymp. Sig.	.013	.006

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It can be assumed from the Table 3 that asymp.Sig of experimental group is 0,013 < 0,05, so that Ho is rejected. It means that the difference of students' interpersonal intelligences in experimental and control groups exists. In the other word, interpersonal intelligences of students who learn chemistry by using NHT based on MI model different from NHT model only.

Students' Achievement

The data of students' achievement before and after implementation of the learning model can be seen as follows.

Tabel 4 Means and Standard Deviation of Students' Achievement

	Experimental Group		Control Group	
	Pre	Post	Pre	Post
Lowest Score	15	60	10	60
Highest score	60	100	50	95
Mean	35,47	83,4	31,2	78,33
Std Deviation (S)	11,48	10,18	10,51	8,85

The result of the t-test of *post-test* data from both groups can be seen on Table 5 below.

Table 5. The Result of t-test

Type of Data	N	$\overline{X}$	Varian	t_{hit}	t_{Table} (α = 0,05)	Conclusion
Experimental	32	76,67	107,16	2,22	2,00	Significant different
Control	33	68,10	80,73			

Based on the calculation of t-test it can be assumed that H_0 was rejected. On the other word, it can be said that there is a significant difference between the experimental and control group shown by t_{cal}> t table (2,22 > 2,00 with db = 63 and α = 0.05) .

IV. DISCUSSION

Viewed from multiple intelligences test result, the development of student intelligence was happened, both in the control and experimental groups before and after learning. The following diagram illustrates multiple intelligences percentage scores of the control and experimental groups before and after implementation of the model..

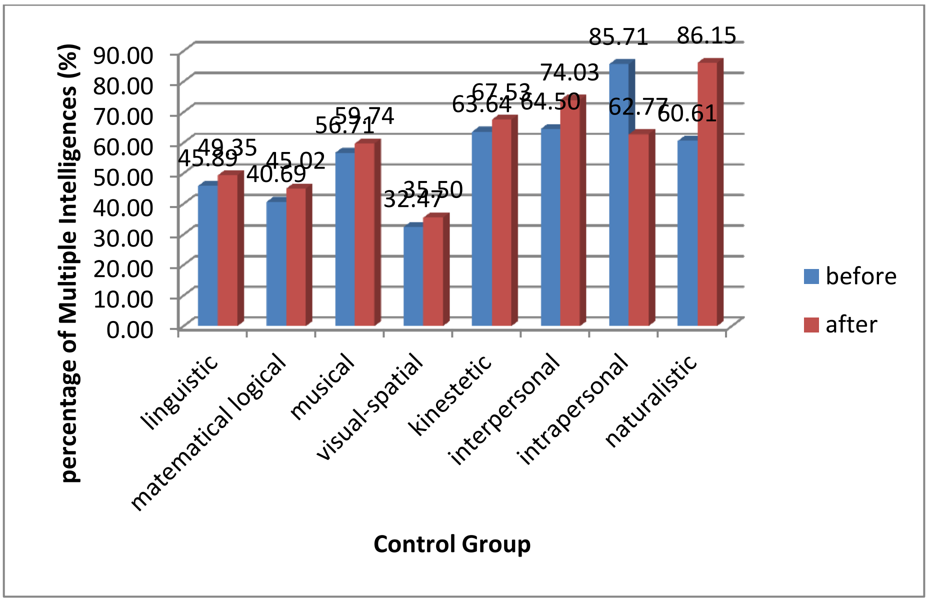
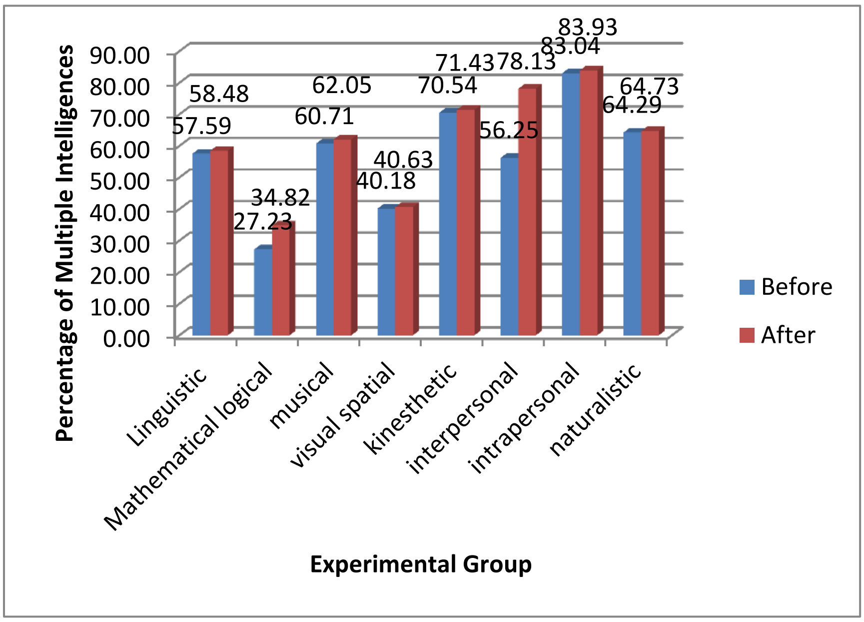


Fig.1. Percentage of multiple intelligences of control group

Fig..2.



Percentage of multiple intelligences of experimental group

Figure 1 and 2 above show that interpersonal intelligence of both groups were increased, but the increase of experimental group is higher than control group. It's supposed to be happened because both of class applied cooperative learning model which make students actively learn.

Then, based on the distribution of 4 dominant intelligences determined by the highest score, the development of dominant intelligences of students in both classes before and after learning activity distributed among all types of intelligences. It can be seen in Figures 3 and 4 as follows.

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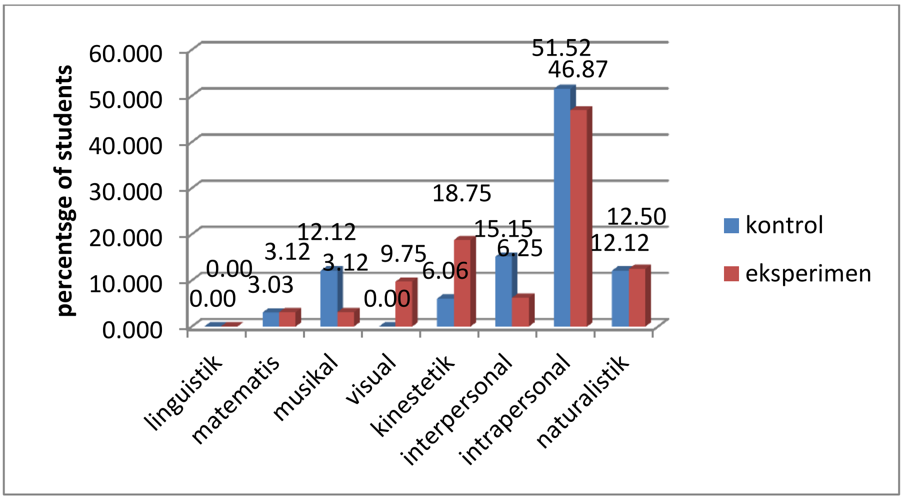

Fig. 3. The development of students dominant intelligences before learning

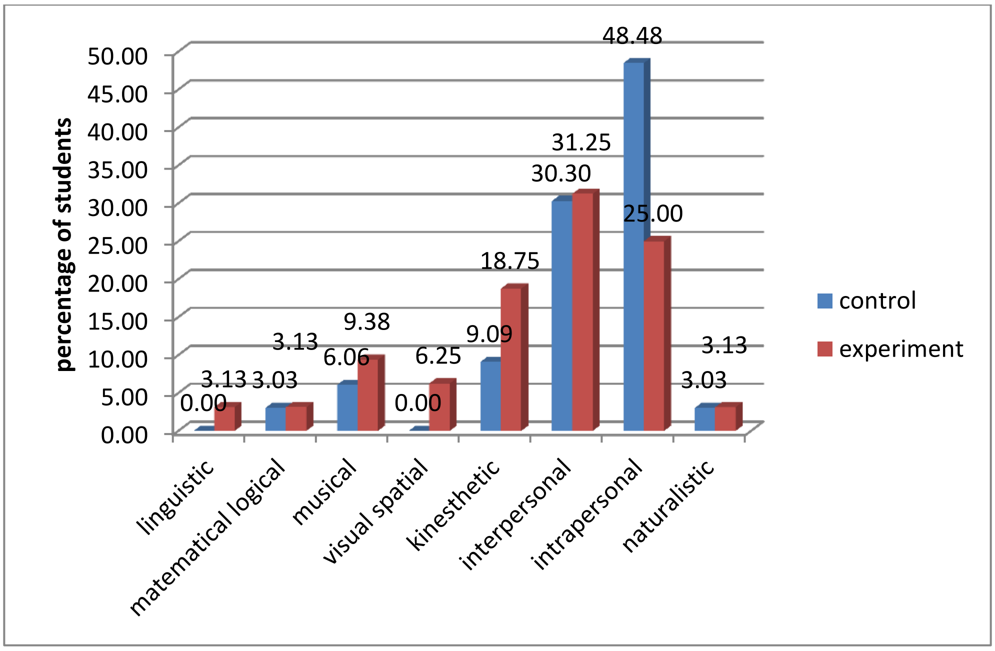

Figure 4. The development of students dominant intelligences after learning

Figure 3 and 4 show that the number of students who have interpersonal intelligence increased after being given the treatment, both in control and experiment groups. However, the number of students who increase in experimental group is higher than control group. It means that the integration of MI theory in NHT model are more effective to increased student interpersonal intelligence than NHT model only. It's accordance with research conducted by Wahyudi (2011) which found that integration of interpersonal activities in learning increased students' interpersonal intelligence.

Nevertheless, the development of students' interpersonal intelligences is not big enough, considering this research only carried out for 2 weeks. While the research of Posciak and Settles (2007) found that to develop student dominant intelligence takes about 10 weeks.

The result found that the development of students' interpersonal intelligence happened both in control and experimental groups, but experimental group develop higher. It also proves that the improvement of students' interpersonal intelligence not only due to integration of MI theory in NHT model but also because of implementation of cooperative learning model. It accordances with research conducted by

Handayani (2007) which found that implementation of cooperative learning improves students multiple intelligences, especially interpersonal intelligence.

Viewed from students' achievement, the improvement of control class (48,4) is almost the same with experimental class (48,6). It can be argued that the integration of MI theory in NHT model helps students in mastering material of Salt Hydrolysis, although the differences are relatively small.

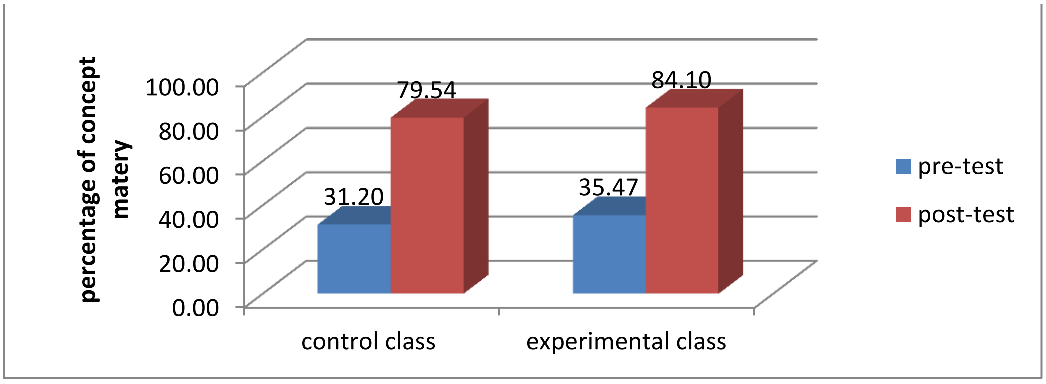

Fig. 5. Improvement of Students' Mastery Concept in Experiment and Control Groups.

The improvement of students' achievement on both groups due to learning activities who let students to discuss difficult concepts of the lesson materials. Yet, unlike the control group, students in experimental group were given more opportunities to interact each other through learning activities which is integrated with MI theory such as chain messages, forming groups based on the same dominant intelligence. That's why students' mastery concept and interpersonal intelligences of experimental group improve better.

Indeed, integration of MI theory in NHT model was conducted by modifying the syntax of NHT, such as making chain messages relates to the material that will be taught at the initial stage. In this stage, 6-8 students are asked to stand up in front of the class and deliver the message chain, with the following statement:
"*The salt formed from a weak acid and weak base is totally hiydolized. The nature of this solution depends on the relative strengths of acids (Ka) and alkaline (Kb)* "
This activity will be considered successful if the message read by the last students is correct. Another modification of the syntax was conducted in division of the group by considering various dominant intelligence and students' learning outcomes. Similarly, in the presentation of material phase, teacher asks students who understand better to tutoring another student. It is a kind of teaching strategy in multiple intelligences, where students trying to teach the lesson material to others need to be more actively communicate each others. By doing these activities, at the same time students' achievement as well as interpersonal intelligences improve better. It shows that integration of Multiple Intelligences theory in Number Head Together (NHT) model increases the effectiveness of NHT model proven by the improvement of students' interpersonal intelligence and concept mastery.

V. CONCLUSION

Based on the research, it can be concluded that integration of Multiple Intelligences theory in chemistry lesson improves the effectiveness of NHT model, with the following indicators.
(1) Compared to the control group, interpersonal intelligence of students in experimental group develops better. Students' interpersonal intelligence in experimental group who learn chemistry by NHT-based on MI model increased by 25%.
(2) Learning outcome of both groups is almost the same, but compared to the control group, learning outcome of experimental group students who learn chemistry by NHT based on MI model was slightly higher. Students' achievement of experimental group increased by 48,6%, while control group increased by 48,4%.

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CE – 02

Construction of Chemistry Teaching Material Using Organic-LED (OLED) Context for High School Students

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Abstract— Science education should really be able to project students not only to obtain knowledge, but also to apply those knowledge. This is triggered by the establishment of the AEC, which challenges Indonesian resources to compete with foreign resources. In addition, young generation faces major challenges in providing sufficient water, food and energy as environment continue changing. But in fact, the ability of students' scientific literacy is still very low, indicated by PISA 2012 study. Content-oriented curriculum and learning process is one of the reason. Meanwhile, many countries that have implemented contexts-oriented instruction project such as Finland (Phenomenon teaching), Germany (Chemie im Kontext), US (ChemComm) and UK (Salters) are considered as successful educational system countries according to PISA. Therefore, this study focused on the construction of Chemistry teaching material using OLED as context. OLED is chosen because it is up-to-date, relevant to real life even for the next decade and closely related to the process competence. This study used Model of Educational Reconstruction that combined students' preconceptions and scientists' perspectives on OLED and high school curriculum objectives. Students' preconception is obtained through interviews, while scientist's perspective is obtained through the analysis of OLED and related chemical contents from textbooks and journals. Both data were analyzed for compliance with high school curriculum. The results of this study stated that OLED-context teaching material includes chemical concepts as follows: Bohr's Theory of energy level, Electromagnetic Radiation, Chemical Bonds (in Solids), Electrolysis, Alkenes, Redox, Aromatics and Polymers.
Keywords: *chemistry, construction, context-based, OLED, teaching material*

I. INTRODUCTION

On this day, education is an important key in the development of human resources. With the establishment of the AEC (ASEAN Economic Community) at the end of 2015, the quality of Indonesian resources in Indonesia should be increased in order to compete with foreign resources. On the other hand, changes in the world continue to occur and followed by the challenges that accompany it. Emerging challenges such as providing sufficient water and food, controlling diseases, generating sufficient energy and adapting to climate change should be capable to be faced by young people. To face these challenges, it required a large contribution of science and technology. Therefore, the purpose of science education should be both broad and applied..

The study of PISA (Programme for International Student Assessment), which organized by OECD (Organization for Economic Cooperation and Development) since 2000 to 2012 show things that are not in line with the expectations declared before. Indonesian students' performance in scientific literacy in year 2000-2012 remained at low levels.

According to the Firman (2007), and Hayat and Yusuf (2010), a low level of Indonesian students performance in scientific literacy is suspected caused by the content of curriculum (experimental activities and teaching materials), learning process and assessment conducted that does not support the exploration of scientific literacy. All of them are too focused on the dimensions of the content (knowledge of science) whilst ignoring other dimentions, e.g. knowledge about science, process / competence (thinking skills) and the context of science application (such as technology).

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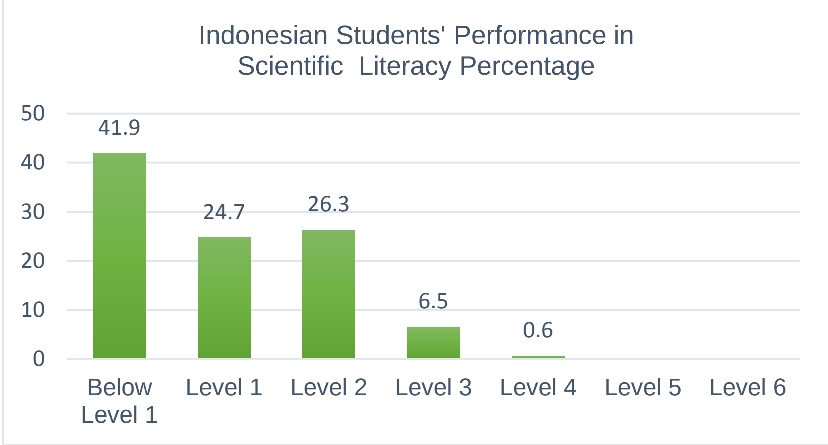

FIGURE 1. INDONESIAN STUDENTS' PERFORMANCE IN SCIENTIFIC LITERACY PERCENTAGE ACCORDING TO PISA 2012 RESULT

Meanwhile in some advanced countries, the trend of learning has shifted from conventional learning into context based learning / topic. The goal is to prepare students to face the world of work is considered important for the industry and modern society. Finland is one of many countries that implementing this learning trend. The result, based on PISA study, revealed that Finland education system is considered successful (OECD, 2010).

From the 1980s, context-based curriculum projects were implemented in mainstream chemistry courses, for instance, the USA project of 'Chemistry in the Community' (ChemCom) and the UK project of 'Salters Chemistry'. Quite recently, new projects were implemented, such as the USA project of 'Chemistry in Contexts: Applying Chemistry to Society' (CiC), and the German project of 'Chemie im Kontext' (ChiK) (de Jong, 2006). According to Otter (2011), the use of context-based teaching materials is guided by several studies such as the lack of interest of students towards science subjects (Ramsden, 2003), the declining interest of students in science at secondary school level (Reiss, 2004; Simpson and Oliver, 1990) and students' asumption that science has no relevance to their lives (Reiss, 2000). Revealed by De Jong (2006), meta-analyzes have been performed by Bennett, Hogarth and Lubben (2003) in 66 studies on the effect of context-based learning approach and the results show that the context-based approach has been successfully motivate students to study science and be able to increase positive attitudes towards science in general.

Based on the explanation above, innovation in science learning content in Indonesia can also be performed by using some particular topics as the context for studying Chemistry. One topic that is considered as up-to-date theme is the Organic Light-Emitting Diode (OLED). Topic OLED is chosen based on three principles of learning science in PISA: relevant to real life situations, still relevant at least for the next decade and closely related to the process competency (Hayat and Yusuf, 2010).

II. PURPOSE OF THE STUDY

Based on all the explanations above, this research focused on the development of Chemistry teaching materials based on modernization of scientific content using OLED topics to be used in the science literacy-based on learning process.

III. METHODOLOGY

The research model used in this study is the Model of Educational Reconstruction (MER) developed by Duit, *et.al.* (2012). The model was designed with the specific purpose of providing a "theoretical framework for studies as to whether it is worthwhile and possible to teach particular areas of science" (Duit, 2007, p. 5). Accordingly, the model has previously been employed in scrutinising comparatively novel fields of science – ones that are not yet in the school curriculum. One basic idea of this model is that the structure of the content for learning can not only be taken directly from the structure of science content, but also must be specially reconstructed by paying attention to education goal and students' cognitive and affective perspective.

MER consists of three components, namely: 1) clarification and analysis of science content; 2) research on teaching & learning; and 3) design and evaluation of teaching and learning environments. The relationship between one components with the other components is not rigid, but recursive.

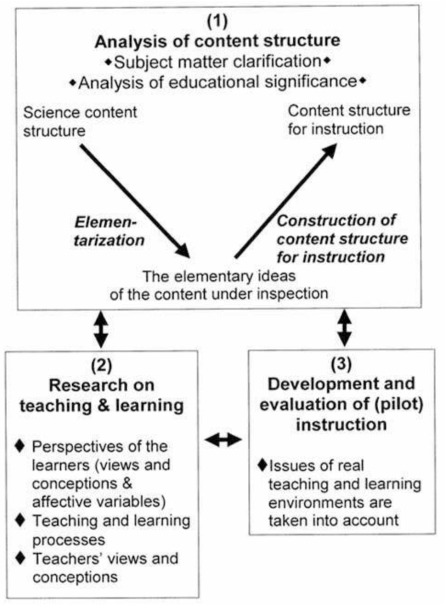

FIGURE 2. THE MODEL OF EDUCATIONAL RECONSTRUCTION (DUIT, 2007, P. 6). REPRINTED BY PERMISSION OF THE EURASIA JOURNAL

The steps being taken in this study are:

1. Analysis of scientist perspective about OLED and Chemistry concepts that related to OLED.
2. Analysis of learner and teacher preconceptions through interview. In general, the content questions include: 1) knowledge of OLED, 2) knowledge of the Chemistry concepts related to OLED, 3) the importance of relating context OLED in learning Chemistry, 4) the urgency of context OLED-based teaching materials and 5) the interest of learner and teacher in using context OLED-based teaching materials.
3. Analysis of curriculum (contents) refered to Kurikulum 2013.

IV. RESULT AND DISCUSSION

A. *Analysis of scientist perspective about OLED*

Definition of OLED

According to Pereira (2012), OLED is defined as light-emitting semiconductor based om organic compounds which have a thickness of 100-200 nm. This thickness is on average a thousand times thinner than a human hair. Overall, the OLED device is about a few millimeters in total thickness. It already includes a substrate (medium that supports the work OLED) and encapsulation structure (organic layer closure to protect them from dust and water). OLED is a self-emitter, meaning that it is not require backlite. Broadly speaking, OLED is divided into two types, namely Small Molecule OLED (SMOLED) and polymerOLED (PLED).

OLED has some advantages compared to the previous light-emitting technologies like LED (Light-Emitting Diode) and LCD (Liquid-Crystal Display). According to Mitschke dan Bäuerle (2000), those advantages are:

1. Can be made to be very thin, thus allowing it to be used in roll-up television
2. It is cheaper to be produced
3. More efficient in energy consumption than LED and LCD
4. Tunability of color emission is better than LCD

Stucture of OLED

The basic structure of OLED is an organic material which is positioned between the cathode and the anode made from transparent conductive glass, ITO (indium tin oxide). The organic material consists of several thin layers, including *Hole Transporting Layer* (HTL), *Emission Layer* (EL) and *Electron Transporting Layer* (ETL).

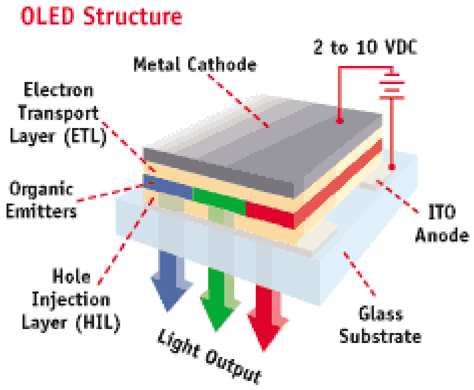

FIGURE 3. BASIC STRUCTURE OF OLED

a. Substrate, glass or plastic foil. Its function is to support the workings of the OLED.
b. Transparent anode. The anode removes electrons (adds "holes" or electron defect) when a current flows through the device.
c. *Organic layer*. This layer consists of organic molecules or polymers.
d. *Emissive layer*, this layer is made of organic plastic molecules (different ones from the conducting layer) that transport electrons from the cathode; this is where light is made. One polymer used in the emissive layer is polyfluorene
e. Cathode (may or may not be transparent depending on the type of OLED). The cathode injects electrons when a current flows through the device.

Characteristic of OLED

As was mentioned above, OLED is a semiconductor device that use organic compound, usually a polymer, as basic materials. So far, the polymer which we know is an electrical insulator. However, the polymer used in OLEDs are conductive polymers that can conduct electricity.

In 2000, A.Heeger, H.Shirakawa da nA.McDiarmid received the Nobel Prize in Chemistry for the discovery and development of conductive polymers. The key in electrical conductivity of the polymer is the presence of conjugated system. Conjugated system is a state where the position of double bonds and single bonds between carbon atoms is conjugated. With the presence of conjugated system, the energy gap in the organic molecules decrease so that polymers turns into a semiconductor.

The presence of conjugated system in polymer does not automatically make the polymer becomes an electrical conductor. To become electrically conductive, the plastic has to be disturbed - either by removing electrons from (oxidation), or inserting them into (reduction), the material. The process is known as doping.Through the redox principle, electrons will be easy to move and flow through the molecule to creates an electric current.

There are two types of doping, oxidation or reduction. In the case of polyacetylene the reactions are written like this:

Oxidation with halogen (*p*-doping): $[CH]_n + 3x/2\ I_2 \rightarrow [CH]_n^{x+} + x\ I_3^-$
Reduction with alkali metal (*n*-doping): $[CH]_n + x\ Na \rightarrow [CH]_n^{x-} + x\ Na^+$

In the first of the above reactions, oxidation, the iodine molecule attracts an electron from the polyacetylene chain and becomes I_3^- . The polyacetylene molecule, now positively charged, is termed a radical cation, or *polaron*.

The doped polymer is a salt. However, it is not the iodide or sodium ions that move to create the current, but the electrons from the conjugated double bonds. Furthermore, if a strong enough electrical field is applied, the iodide and sodium ions can move either towards or away from the polymer. This means that the direction of the doping reaction can be controlled and the conductive polymer can easily be switched on or off.

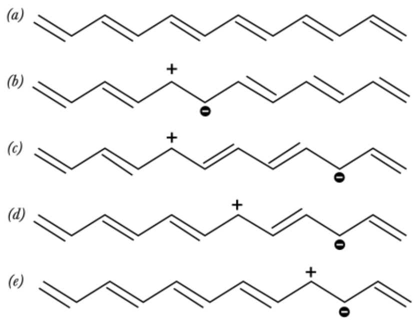

FIGURE 4. FORMATION AND MOVEMENT OF POLARON

How OLED work

Emission of light in the OLED occurs through a process called electroluminesence. In their study, Mitschke dan Bäuerle (2000, hlm. 1471) stated the definiton of electroluminesence (EL) as a non-thermal generation of light resulting from the application of an electric field to a substrate. In the latter case, excitation is accomplished by recombination of charge carriers of contrary sign (electron and hole) injected into an inorganic or organic semiconductor in the presence of an external circuit.

When the electron-hole recombine (merge) in the organic molecules, it formed exciton. Exciton have the same nature as single molecules, but in higher energy. This exciton produce light after its period of lifetime. The wavelength of the light emission produced depends on the exciton energy. Therefore, we can control the color produced by regulating the energy through the selection of the organic material. This is the advantage of OLED displays (Tsujimura, 2012).

Here is an overview of the basic principles of electroluminesence process that occurs in OLED (Banerji, *et. al.*, 2012).

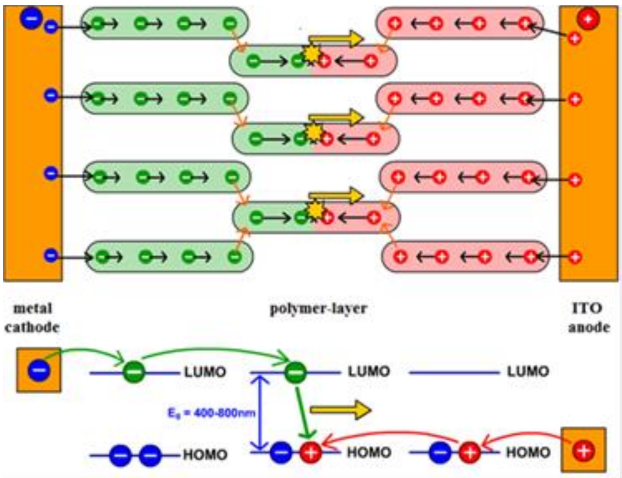

FIGURE 5. PRINCIPLE OF ELECTROLUMINESCENCE IN AN OLED (BANERJI, TAUSCH & SCHERF, 2012)

a. Charge Injection
   In a first step electrons are injected into the LUMO1 of molecules close to the cathode and holes are injected into the HOMO1 of molecules close to the anode.
b. Charge transport
   Via hopping processes (red arrows in Figure 5) the injected charges drift through the polymer layer from molecule to molecule in opposite directions.
c. Charge recombination and decay of excitons
   When electron and hole meet inside a molecule they recombine to give an exciton.

B. Analysis of Chemistry concepts related to OLED

Based on the analysis of context OLED, Chemistry concepts related to OLED can be illustrated in the following figure.

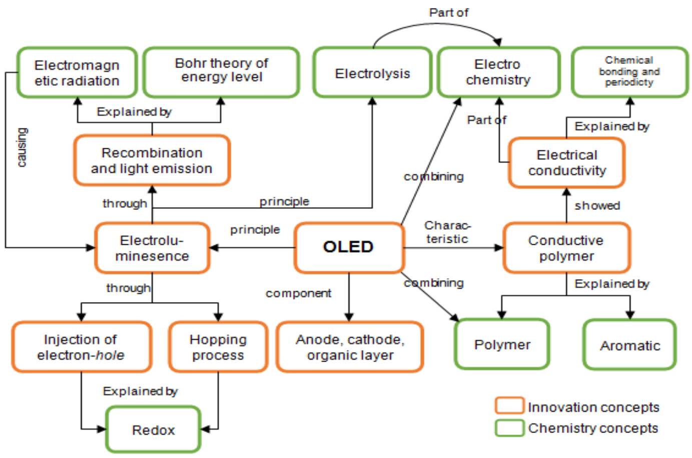

FIGURE 6. SCHEME OF CONTEXT OLED AND RELATED CHEMISTRY CONCEPT

According to the scheme above, chemistry concepts related to OLED are:

1. Bohr's Theory about energy level, to describe light emission process
2. Periodicity, to describe electrical conductivity of semiconductor
3. Organic compound, related to basic material of OLED
4. Polymer, especially conductive polymer
5. Alkene and aromatic compound to describe conjugated system
6. Redox and electrolysis, to describe principle of OLED that makes conductive polymer can emitt lights.

All of those high school Chemistry concepts are adapted to Kompetensi Inti and Kompetensi Dasar Kurikulum 2013 to make it appropriate with national education goals.

C. Analysis of learner and teacher preconceptions about OLED and related Chemistry concepts

The study was conducted through interviews adapted from Laherto (2012). Interviews were conducted on 10 students and three teachers of High School Chemistry. The interview consist of 14 items with a free answer format. The aim is to explore preconceptions that exist in respondents mind. Interview items divided into four parts. Items 1-7 explores the knowledge of the context OLED. Items 8-9 explores the knowledge of chemistry concepts related to the context OLED. Items 10 explore the opinions of respondents on the importance of linking the context OLED in learning Chemistry. Meanwhile, the fourth part consists of items 11-14, explores the respondents' opinions on the urgency of using OLED context-based teaching materials.

Comparison between the preconceptions of students and teachers with scientist's perspective can be seen in the chart below:

TABEL 1. COMPARISON BETWEEN THE PRECONCEPTIONS OF STUDENTS AND TEACHERS WITH SCIENTIST'S PERSPECTIVE

	Students	**Teacher**	**Scientist's perspective**
Knowledge about OLED	Sophisticated technology on TV that makes it has better features	Developments technology of organic-based light emitting material that makes it has better features	Diodes from organic materials that can emit light which have thinner structures and better quality than LED
Principle of OLED	Most do not know, but some of them answered combination of physics and chemistry	Using the principles of electrochemistry, chemical bonding and electromagnetic radiation	Electroluminesence, ie emission of light by electric current
Chemistry concepts related to OLED	Mostly answered correctly, ie electrolysis, organic compounds, chemical bonding, redox, polymers and electromagnetic radiation. Others have not been correct: static and dynamic electricity	Organic compounds (associated with the basic materials OLED), electrochemical (because of similarities with the OLED principle of electrolysis), electromagnetic radiation / atomic structure (related to the emission of light) and chemical bonds (as an explanation of OLED components). However, redox concept unfortunately does not appear as the main principle of OLED	Organic compounds (conjugated system), redox (electron transfer concept), electrolysis, atomic structure (the Bohr atomic theory of energy levels)

V. CONCLUSION

OLED context-based teaching materials developed by MER with considering three stages. Results from students and teachers preconceptions showed that their knowledge of OLED is still not correct, but they showed a positive attitude towards the construction of these teaching materials. Chemistry concepts associated with OLED are organic compounds (conjugated system), redox (electron transfer concept), electrolysis, atomic structure (the Bohr atomic theory of energy levels).

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CE – 03

Chemistry Teachers' Ability in Measuring Analitycal Thinking and Science Process Skills

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Abstract—The objectives of the study to investigate chemistry teachers' ability in measuring students' analitycal thinking and science process skills. This subject research is chemistry teachers' of XI IPA classes of five senior high schools in Yogyakarta. Data collecting technique used questionnaire and was analyzed in qualitative-descriptive method. The result of the qualitative analyze shows that: 1) some of the subject research teachers do not have the assessment instrument, 2) assessment laboratory activities have not using the assessment instrument, and 3) assessment instrument is not equipped with standard scoring guidelines. On the other hand, the chemistry teachers' ability in measuring analitycal thinking and science process skills is low. Therefore, chemistry teachers should be improved their ability in measuring analitycal thinking and science process skills.

Keywords: *analitycal thinking, assessment instrument, science process skills*

I. INTRODUCTION

Chemistry learning in 21st century requires active participation of teachers to optimize the overall students' abilities on aspects of knowledge, skills, and attitudes. Knowledge related to the cognitive, psychomotor related to the skills, and attitudes related to the affective domain. Knowledge is a process of remembering, associating, assessing, and interpreting a particular phenomenon. Manual skill is the ability possessed by the students to do laboratory activities well. Attitude is a state of mind, feelings, or beliefs about a particular issue embodied in the learning activities [1]. All three of these competencies can be built through a scientific approach by using inquiry-based learning.

Inquiry-based learning is one method of learning centered on students who can improve learning outcomes of students, especially the development of higher skill. In other words, inquiry-based learning can strengthen the relationship between learning in the classroom theory with practical activities in the laboratory [2]. Inquiry-based learning is one of suitable method to apply in learning chemistry because the model facilitates the students to actively carry out an investigation in the lab activities. Inquiry-based activity involving a series of practical dimensions of knowledge students related components conceptual, procedural, and operational [3]. These three components can be obtained through practical activities that are supported by the use of science process skills.

Science process skills are intellectual skills that can be practiced, studied and developed by students through a learning process, so it makes students better prepared to face the challenges of the 21st century learning [4]. Science process skills need to be applied to students because it indirectly will involve them in different activities and be able to direct their inquiry to apply basic science process skills and integrated [5]. These results are reinforced by the opinions Yakar [6] who argued that science process skills-based learning can also increase the positive attitude of students towards science. Thus, science process skill is able to accommodate aspects of knowledge, skills, as well as scientific attitude of the students in an integrated manner.

Competence in the science process skills should be seen as an instrument that will help students to acquire knowledge and understanding of how knowledge is acquired [7]. In the context of learning, science process skills are not directly linked to the cognitive dimension [8]. The cognitive dimension includes the students' ability to remembering, understanding, applying, analyzing, evaluating, and creating [9]. In general, the cognitive dimension in Bloom's taxonomy is divided into two levels of thinking, the low order thinking skills and high order thinking skills. Capabilities included in the low order thinking skills include the ability of remembering, understanding, and applying. While the capabilities included in the high-level thinking skills include the ability of analyzing, evaluating, and creating [10]. One of high-level thinking skill needed to support students' academic success in the 21st century is the analytical thinking ability.

Analytical thinking is the thinking skills needed by students to understand the elements or holistic view. Analytical thinking is required to understand the interactions that occur between elements simultaneously connect these elements in a system in a comprehensive manner [11]. Analytical thinking is often used to solve complex problems and then make logical decisions based on the information obtained. A major component in analytical thinking consists of the ability to understand, analyze, and evaluate arguments. These components can be presented in the form of items that represent a problem. Then the problem is solved using a variety of approaches in the form of answers that need solving the problem in depth. Types of problems that have the ability to analyze are often used to measure the high order thinking skill accordance Bloom's taxonomy.

In the process of learning the need for the continuous assessment that teachers and students know the extent of achievement of the learning materials they have done. The principles in the assessment need to be done in order to provide a more optimal result in further learning. Assessment dimensions of cognitive and psychomotor will be more effective when carried out using an integrated assessment instruments. Integrated assessment is defined as a form of assessment involving all kinds of different assessment, such as written assessment (theory) and demonstration (practice) together with the aim to determine the competency of students [12]. In other words, the integrated assessment is an assessment that integrates the analytical thinking once science process skills together.

Assessment analytical thinking and science process skills can be done using a written test. One type of assessment using a form of written tests is a essay test. Essay test is a test that requires students to express the power of reason, so that the answers given will indicate the ability of complex thought. Scoring essay test can be done based on the quality of answers in every step of the completion of the given [13]. Excellence essay test form which capable of measuring the power of thought and the various aspects of the science process skills of students, so the essay test has the potential to be developed as an assessment instrument analytical thinking and science process skills. Therefore, the analytical thinking and science process skills need to be taught to students early in order to help students solve problems in meeting the challenges of the 21st century chemistry learning.

In order to teach and assess the skills and abilities of students effectively, then the teacher must have an understanding of the operational and adequate conceptual about analytical thinking and science process skills [14]. If teachers have a low understanding of the analytical thinking and science process skills, then the possibility of science process skills teachers teach and analytical thinking will also be low. Such conditions would have a negative impact on the ability and skills of students in solving problems. Low science process skills will affect the analytical thinking of students in achieving academic success. This is because the conditions associated with the academic success of science process skills [15-21]. Students who are less trained science process skills are less likely to have good success [15]. Therefore, analytical thinking and science process skills needs to be assessed and taught to students early on so they trained in dealing with various problems in learning and the environment.

II. RESEARCH METHOD

This study used a qualitative approach with descriptive research. Qualitative research is research that describes and explains the experience, behaviors, interactions, and social context without actually using statistical procedures or quantification [22]. Qualitative research can use several techniques of data collection, which includes interviews, observation, and an open questionnaire [23]. The questionnaire is one of the main sources for obtaining data in the study. The questionnaire used in this study is a kind of open-ended questionnaire consisting of five questions.

The research was conducted on September 5 to 19, 2015. The subjects were five chemistry teachers of XI IPA classes of five Senior High Schools in Yogyakarta with between 6-28 years of teaching experience. Sampling was done by purposive sampling by considering school rankings (high, medium, and low) according to national test results for the senior high school (SMA/MA) grader to chemical subjects in 2015. The research subjects include MA Negeri 1 Yogyakarta, SMA Negeri 2 Yogyakarta, SMA negeri 4 Yogyakarta, SMA Negeri 6 Yogyakarta, and SMA Negeri 10 Yogyakarta. Any number of participants used in qualitative research is valid data as a source of information [24].

III. RESULTS AND DISCUSSIONS

In this study, the instrument used to collect data about the chemistry teachers' abilities in measuring analytical thinking and science process skills consists of 5 questions open-ended questionnaire. The questionnaire was given to five chemistry teacher which has a long teaching qualification more than 5 years. Reasons were selected based on the assumption that teachers are experienced in teaching, so it has a good knowledge of the chemical material, in particular the rate of reaction material. The fifth question relates to the ownership of the assessment instrument, how to conduct the assessment in practical activities, and the use of scoring guidelines in practical activities. In general, the results of the study are described as follows.

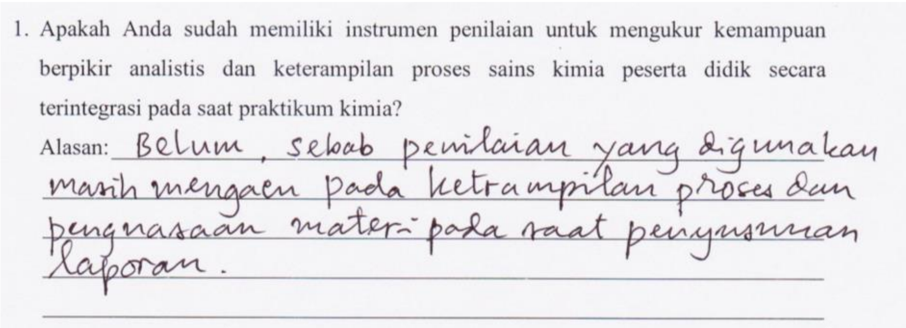
A. Assessment Instrument

Assessment instrument is a tool used to measure comprehension, mastery, and to apply the specific-scientific topic or concept that has been done by students accurately [25]. The item in the questionnaire relating to the ownership of assessment instruments contained in the questions 1 and 2.

1) Question 1

Do you already have an integrated assessment instrument to measure students' analytical thinking and science process skills during practical work in a laboratory?

Based on question 1, the result that most teachers do not have an assessment instrument is to measure students' analytical thinking and science process skills during practical work in a laboratory. Ratings used to be limited on the skill and mastery of the material at the time of preparation of the practicum. In addition, the assessment instruments used do not measure the abilities and skills of students in detail or only in outline. The impact when the measurement capabilities and analytical thinking are not using science process skills assessment instrument is the result obtained is not accurate. In addition, the assessment has been carried out allowing the element of subjectivity assessors to students. One example of the results of the questionnaires by the teacher in the question 1 is presented in Fig. 1.


1. Apakah Anda sudah memiliki instrumen penilaian untuk mengukur kemampuan berpikir analistis dan keterampilan proses sains kimia peserta didik secara terintegrasi pada saat praktikum kimia?

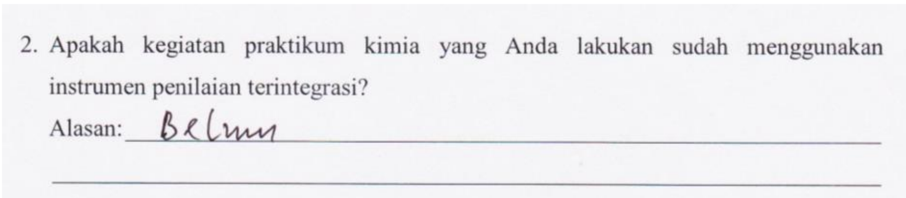
Alasan: Belum, sebab penilaian yang digunakan masih mengacu pada ketrampilan proses dan penguasaan materi pada saat penyusunan laporan.

Figure 1. Teachers' Response to the Question 1

2) Question 2

Are the chemistry laboratory activities that you do already use integrated assessment instrument?

Integrated assessment is a form of assessment involving all kinds of different assessment, such as assessment of the analytical thinking and science process skills together with the aim to determine the competency of students. Based on question 2, showed that the vast majority of teachers do not use the integrated assessment instrument during chemistry laboratory activities. It is seen from the activities of teachers who only use direct observation in assessing the practical activity regardless of the indicators contained in process skills. In addition, the measurement of the analytical thinking is not optimal, and the measurement is performed separately from the practicum. One example of the results of the questionnaires by the teacher in the question 2 is presented in Fig. 2.


2. Apakah kegiatan praktikum kimia yang Anda lakukan sudah menggunakan instrumen penilaian terintegrasi?

Alasan: Belum

Figure 2. Teachers' Response to the Question 2

Cognitive dimension measurement performed by the teacher using a presentation about the still dominant limited remembering, understanding, and applying. It will actually make the ability of students is only used to resolve low-level cognitive problems. In fact, the analytical thinking is a high-level cognitive that can be achieved after the students master the low-level cognitive as to remembering, understanding,

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and applying. The problems arise because teachers are yet to optimize the analytical thinking and science process skills in the learning process. In addition, science process skills are rarely taught in laboratory activities because teachers assume that students can acquire these skills through practical experience in the laboratory by itself [26]. Thus, students will not have a clear concept in carrying out laboratory work skills.

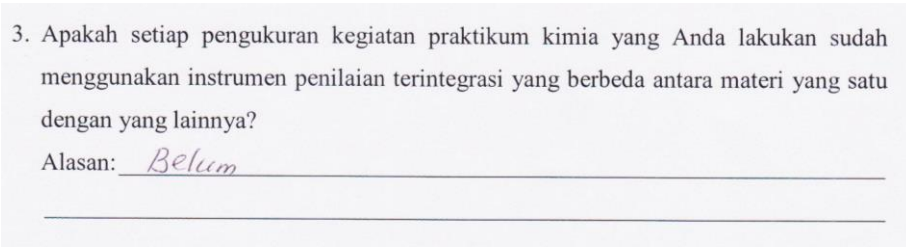
B. Practical Activity Assessment

Assessment is a way of practical activities undertaken by teachers to obtain relevant information in practical activities. The results obtained in the assessment of practical activities used to determine learning outcomes, the specific individual circumstances, and improve the learning process have been done. The success of practical activities will be evaluated based on the findings or obstacles which were acquired during previous practical activities. In general, the items in the questionnaire relating to how to vote in the lab activities are in the question number 3 and 4.

1) Question 3

Does each measurement chemistry laboratory activity that you do already use integrated assessment instrument that is different between the material with each other?

Based on question 3, the result that most of the teachers do not use the integrated assessment instrument that is different between the material with each other at the time of measurement chemistry laboratory activities. In general, teachers assess practical activities based on reports from the lab that has been done by students. In addition, the practicum is only just taken from the final stage of practical activities. Thus, the assessment of practical activities between the subject matter of which one with the other is not done using the integrated assessment instruments. One example of the results of the questionnaires by the teacher in question 3 is presented in Fig. 3.


3. Apakah setiap pengukuran kegiatan praktikum kimia yang Anda lakukan sudah menggunakan instrumen penilaian terintegrasi yang berbeda antara materi yang satu dengan yang lainnya?

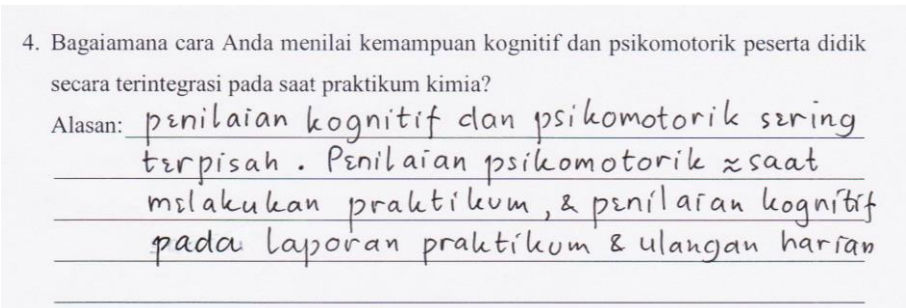
Alasan: Belum

Figure 3. Teachers' Response to the Question 3

2) Question 4

How is the way you assess cognitive and psychomotor students integrated during chemistry laboratory activities?

Based on question 4, the result that often teachers assess the cognitive and psychomotor is separately. Assessment of cognitive ability is based on the results of the lab report made by students, whereas psychomotor assessed by observation during the practical work in a laboratory. In practice, teachers only judge about discipline and cooperation of students when carrying out practical work. This leads to an assessment of the learning outcomes of students performed less effective and efficient, both in the planning, implementing, and reporting. Moreover, teachers will have more work to the assessment and administration of students' learning outcomes. One example of the results of the questionnaires by the teacher in the question 4 is presented in Fig. 4.


4. Bagaiamana cara Anda menilai kemampuan kognitif dan psikomotorik peserta didik secara terintegrasi pada saat praktikum kimia?

Alasan: penilaian kognitif dan psikomotorik sering terpisah. Penilaian psikomotorik ≈ saat melakukan praktikum, & penilaian kognitif pada laporan praktikum & ulangan harian

Figure 4. Teachers' Response to the Question 4

C. Scoring Guidelines

The scoring guidelines is a guidelines in determining the score of the work of students in an objective and accountable. Scoring guidelines is important to be prepared as well as possible by teachers using clear measures in order to provide an authentic score of answers to students [27]. The item in the questionnaire related to the use of scoring in the practicum guidelines contained in question 5.

1) Question 5

Do you have scoring guidelines for integrated assessment instrument between the cognitive and psychomotor?

Based on question 5, the result that most teachers do not all have the scoring guidelines for integrated assessment instrument between cognitive and psychomotor aspects. Teachers find it difficult to design and develop guidelines for scoring the assessment tool is integrated between cognitive and psychomotor aspects. The difficulties appear due to lack of teacher knowledge about the correct preparation of scoring guidelines. In this case, this section serves as a guide for scoring results and increasing objectivity in scoring. In addition, the guidelines need to be made scoring with a clear indication that the inspection of students' work can be done with the same standard. If teachers do not have the scoring guidelines on cognitive and psychomotor aspects in an integrated manner, the assessment has not been conducted objectively. This is contrary to the Regulation of the Minister of Education and Culture No. 66 of 2013 about standard assessment in education which states that the principles of such assessment must be integrated, economical, and objective [28]. One example of the results of the questionnaires by the teacher in the question 5 is presented in Fig. 5.

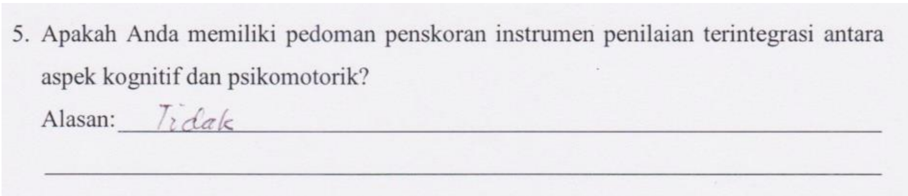

5. Apakah Anda memiliki pedoman penskoran instrumen penilaian terintegrasi antara aspek kognitif dan psikomotorik?
Alasan: Tidak

Figure 5. Teachers' Response to the Question 5

Practical activity requires an assessment instrument to be able to measure the students across the ability or competence should be measured precisely. Assessment instruments need to be designed according to the indicators of learning materials that are the standard of competence and basic competence in the applicable curriculum. However, the fact the teacher has not had an integrated assessment instrument to measure the analytical thinking and science process skills during chemistry laboratory activities. In addition, assessment also needs scoring guidelines in order to maintain consistency in the scoring gives a score for each job students. Scoring guidelines need to be prepared to use measures which systematically appropriate measures in order to facilitate the process of workmanship matter of scoring learning outcomes and avoid bias. Based on the research that has been conducted shows that teachers are also not entirely have the scoring guidelines for integrated assessment instrument between cognitive and psychomotor aspects.

Although teachers are the subject of the research has a relatively long teaching experience, but that experience does not necessarily indicate that their understanding in measuring the analytical thinking and science process skills considered good. Teachers realize that the old teaching is not necessarily able to improve control of their competence in carrying out a series of learning activities [29]. In practice, teachers focus on teaching to complete the syllabus content and deliver information in order to prepare students for public examinations [30]. This causes less teacher attention to the aspects that should be assessed in practical activities.

The level of understanding and mastery of teachers' science process skills are also associated with the level of understanding and mastery of students' science process skills [3]. Teachers who lack the conceptual knowledge of the science process skills will use the strategy of inquiry learning, so they will not emphasize these skills in the classroom [31]. Although they carry out practical activities, however, teachers have no knowledge of the underlying conceptual skills [32]. Thus, analytical thinking and science process skills owned by students will tend to be low. Low analytical thinking and science process skills will result in the inability of students in solving problems that require a high level of analytical thinking skills. Further impact that would adversely affect the students are led to the unpreparedness of students for the challenges of the 21st century chemistry learning increasingly complex.

IV. CONCLUSIONS AND SUGGESTIONS

The result of the qualitative-descriptive analyze shows that: 1) some of the subject research teachers do not have the assessment instrument, 2) assessment laboratory activities have not using the assessment instrument, and 3) assessment instrument is not equipped with standard scoring guidelines. On the other hand, the chemistry teachers' ability in measuring analitycal thinking and science process skills is low. Therefore, chemistry teachers should be improved their ability in measuring analitycal thinking and science process skills through composing standardized test.

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CE – 04

THE IMPROVEMENT OF STUDENTS' ACHIEVEMENT AND SOCIAL MATURITY ON CHEMISTRY LEARNING THROUGH THE ASSISTANCE OF LOCAL WISDOM VIDEOS

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Abstract- The awareness of the strength of local wisdom in the development of students' characters lead to the need of teachers to integrate local wisdom contents into learning, including Chemistry learning. In this research, local wisdom contents were integrated into chemistry contents of electrochemistry, and presented in the formats of videos. The videos were used as enrichment materials, and their effect to students' achievement and maturity were investigated by comparing both data from experiment and control groups. There were 9 videos developed by use of Borg and Gall model. The samples were 40 students in an experiment group, and other 40 students in a control group at the senior high school of MA Muallimat Muhammadiyah Yogyakarta. The difference of learning process between both groups of samples was the use of the videos outside of face-to-face by students at experiment group. After 4 times of face-to-face learning, the improvement of students' achievement was measured by test, and students' maturity was by observation as well as a questionnaire. The comparison of the improvement both students' achievement and maturity were analyzed by MANOVA (Multivariate Analysis of Variance) of SPSS V.16 from which the value of hotelling's trace was 0.983 ($p > 0.000$). It showed that the improvement of achievement and social maturity of students from experiment group was not different from that was from control group as the effect of the use of videos containing local wisdom integration into electrochemistry materials.

Keywords: video, local wisdom, student social maturity, student achievement

I. INTRODUCTION

Educators and governments have been indeed supported by technology, where the transformation of education system is able to be flexible in open distance learning. Technology is the infrastructure and main path of distance education. It is dramatically affecting pedagogic sectors [1]. The high demand of technology use forces educators to develop more and more learning media that enable students to study independently without facing teachers.

Students should be able to search sources for learning themselves. It makes educators facilitate students by using some easy-accessed learning media that enable students to be assisted. Internet is exactly a close friend of students. One of the easiest media to be assessed is videos which can be downloaded and enjoyed wherever, whenever, by who ever, and with whomever. Students are expected to love learning and enjoy the materials especially in electrochemistry materials in chemistry subject. The goal is that students can have better student achievement.

Moreover, education is not only as a sector that focuses on cognitive aspect but also as the sector concerning on affective field. One effort to reach it is by the use of local wisdom that is integrated in videos to integrate students' social maturity. Students are expected to be more responsible to their regions and more aware to the environment. Therefore, using the videos containing local wisdom integration as the technology performance is so important to be developed by educators in order to support governments and educators in developing pedagogic aspects.

II. RESEARCH METHOD

Nine videos were developed through Borg and Gall Model. The videos were assessed by six chemistry teachers. After that, the videos were treated to the students of treatment class. The samples were 40 students from treatment class as well as from control class. The population was the students of Class XII of Muallimat Muhammadiyah Boarding School Yogyakarta, Indonesia. This was an experimental research that had treatment class that had been treated and control class as comparison.

There were two data used in this study. The first one is the data of students' achievement obtained by using pencil- paper test and the second one is the data of social maturity obtained by using questionnaires validated by some experts. Multivariate analysis of variance was the analysis method to measure the improvement difference of two dependent variables (student achievement and social maturity) of both groups.

III. Results and Discussion

Borg and Gall model was used in video development. The materials contained were about electrochemistry related to local wisdom of Yogyakarta. The data of product quality were obtained from reviewer assessment. The data in the format of suggestion were summarised and concluded to revise the videos. Next, the data from some lists of statements in questionnaires were analysed. It was suggested as a good media.

Using videos in learning is so beneficial that it can support students to understand more.[2] stated that media characteristics affect technology- based learning. These facts revealed the need of technology in education field to improve the advance of higher quality of education. In addition, the use of on line video increases students' interest and grow alternative approach in teaching [3]. Furthermore, more-advanced learning needs an alternative tutoring approach to support face to face learning [4]. The videos contain slightly different materials from what teachers teach in class because it is for enrichment program. The difference is that the materials are simpler but still related to the goals of learning electrochemistry. Besides that, the videos can be portable and slower than that is in classroom lectures [5]. Students can replay it if they pass some parts of video. Since the videos can be assessed on line, it enables students to use either in on line classes or direct courses. The latest large- scale survey by [6] claims that students like learning by the use of video. It is quite similar to watching television programs independently and freely. Moreover, it allows students to study at their own pace, with pause, rewind, and instant playback. The main purpose is to improve students' achievement by making an attracting learning.

Integrating local wisdom in the videos were also the efforts to give some stimulant to the students to be more aware in social life. Local wisdom defines as community experiences designed to be knowledge that is contributing in controlling human [7]. That motivating students through inserting local wisdom aspects in education media means controlling students' behaviour indirectly. The focus here is the collaboration of videos and local wisdom to improve both students' achievement and social maturity directly. It is such a particular form of improving outcomes of education [8]. Educators always tried to take efforts of making good outcomes in every round of cyclic path in classrooms. Local wisdom might be wished as the policy to prevent truancy, improve behaviour, or reduce foolishness that were packaged in one attitude tested by using questionnaires (social maturity).

Teachers' roles were creating chemistry learning environment to get the use of the videos. Teachers also functioned as controllers that controlled about not only what students do but also when students speak and make noise [9]. Teachers could also be moderator that can encourage students to participate in responding to the videos. Teachers should give the basic knowledge first to support students' prior knowledge in understanding the materials. After that, teachers also ask the feedback of the videos [10]. If the videos were not watched in class, teachers should control it through some tasks of feed backing videos.

These videos were also tested to the students of both control and treatment classes. The diagram below shows the research design as the steps of this study. First of all, some videos were made and assessed by six chemistry teachers. The assessment included some aspects (materials, language, application, audio performance, and visual) which were assessed by using questionnaires in Likert scale. After that, four face to face learning were held in both classes (treatment and control class). The existence of video assistance was the difference of the treatment in this research. Then, the students filled questionnaires of social maturity as the final data of social maturity. There were the criterions using Likert scale in the questionnaire. The data of Likert scale performed in ordinal data in SPSS. Because of this reason, it had to be transformed first to be interval data in SPSS to enable it be analysed in Multivariate Analysis of Variance with the data of students' achievement that were performed as interval data, too. In order to make sure that the data were homogeny and normal, there must be homogeneity and normality tests for both data (social maturity and student' achievement) in both groups of students.

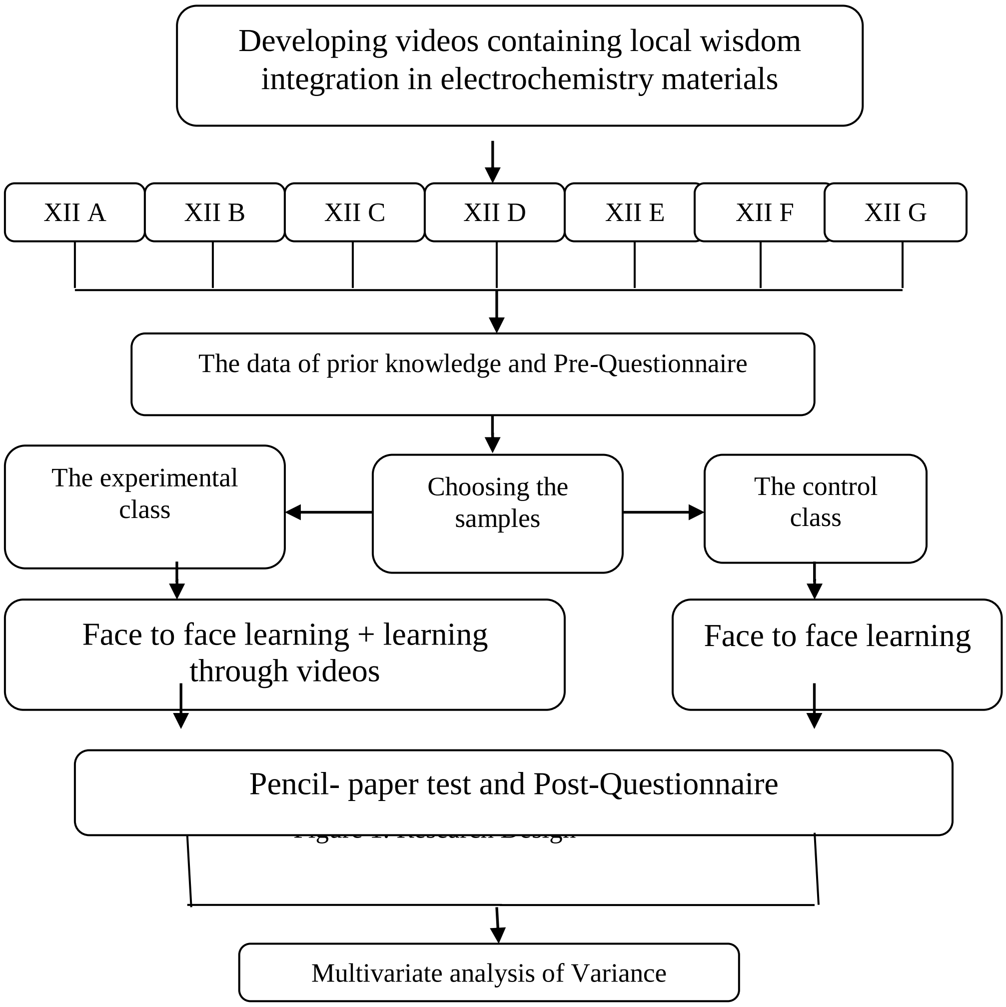

Figure 1. Research Design

Multivariate Analysis of Variance (MANOVA) is a *Hostelling* T^2 test. Two major situations that enable MANOVA is used are when there are some correlated dependent variables and researchers like to make it in a set and when researchers want to explore how independent variables affect some dependent variables [11]. The disadvantage of using this analysis is that it can not solve with multi factorial ANOVA. That is why it cannot cope with the partition variation across many factors in experimental research [12]. Multivariate analysis of variance is when there are two or more dependent variables in a set [13]. Two dependent variables studied in this research were student achievement and social maturity.

Multivarate Test

Intercept	Pillai's Trace	.996	9.456E3[a]	2.000	74.000	.000	18911.654	1.000
	Wilks' Lambda	.004	9.456E3[a]	2.000	74.000	.000	18911.654	1.000
	Hotelling's Trace	255.563	9.456E3[a]	2.000	74.000	.000	18911.654	1.000
	Roy's Largest Root	255.563	9.456E3[a]	2.000	74.000	.000	18911.654	1.000
Kelas	Pillai's Trace	.215	10.129[a]	2.000	74.000	.000	20.258	.983
	Wilks' Lambda	.785	10.129[a]	2.000	74.000	.000	20.258	.983
	Hotelling's Trace	.274	10.129[a]	2.000	74.000	.000	20.258	.983
	Roy's Largest Root	.274	10.129[a]	2.000	74.000	.000	20.258	.983

a. Exact statistic

b. Computed using alpha = .05

c. Design: Intercept + kelas

Figure 2. Multivariate Test

The value of significance at hotelling's trace was 0.983 (p>0) meaning the improvement of student achievement and social maturity of treatment class was not different from that of control class. Such result might be because of the influence of teachers as well as motivational and social engagement [14]. These factors often affected the result of educational study. Teachers could also be the factors that affect it because of their difference in performance, speech, language, and thinking while teaching students. In specific condition, though students, rooms, schools, or some other visible variables are the same between two groups (treatment and non treatment), they might yield difference because of some unobservable variables that could not be controlled [15]. Sex can also affect social maturity itself because it gives different impacts to women and men. In fact, there is a growing proof that showed women and men experienced different sensitive feeling and will. Men act more strongly and lead gently. Besides that, men also could react to be wise. On the other side, women liked keep others' commitment and be more sensitive in feeling [16]. The difference of these could also be the factor that affected the result of this study.

IV. CONCLUSION

This study performed that the students achievement and social maturity improvement of the students from treatment class was not different from those who were from control class after assisted by using videos that contained local wisdom integration in chemistry.

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CE – 05

DEPLOVEMENT OF INTERACTIVE STUDENT WORKSHEET OF CHEMISTRY LEARNING IN SENIOR HIGH SCHOOL (SMA)

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***Abstract*—** This research is a development research that aims to produce a valid, practical, and effective Interactive Student Worksheet of chemistry learning in senior high school. Interactive worksheets were developed include: true-false, multiple choice, multiple choice with more than one correct answer, match, sort, maps, and crossword puzzles. The development model used on is ADDIE development model with five stages: analysis, design, development, implementation and evaluation. The validity based on assessments of two validators and two chemistry teachers. Test the practicality of the device is done by giving a questionnaire on student. The effectiveness is based on N-gain critical thinking skills of students. The trial stiffened in class XI MIA student of SMAN 11 Makassar in the second semester of the academic year 2014-2015. Interactive worksheets were developed have valid, practical and effective criteria. The average results of the validation performed by experts for true-false, multiple choices, multiple choices with more than one correct answer, matching, sequencing, mapping, and crossword puzzles of interactive worksheets are: 4.08; 4.02; 4.27; 4.11; 4.10; 4.38; and 4.25 respectively. Results of the validation by chemistry teacher shows the average value for true -false, multiple choices, multiple choices with more than one correct answer, matching, sequencing, mapping, and crossword puzzles of interactive worksheets are: 4.15; 4.13; 4.05; 4.16; 4.16; 4.16; 4.36; and 4.25 respectively. The percentage of positive responses of students to true-false, multiple choices, multiple choices with more than one correct answer, matching, sequencing, mapping, and crossword puzzles interactive worksheets are: 74.8; 72.2; 71.3; 71.1; 72.5; 75.8; and 75.8 respectively. The average N-gain critical thinking skills of students was 0.45 or medium category.

Keywords: *interactive worksheet, ADDIE development model*

I. INTRODUCTION

Nowdays, Science and Technology develop progressively of which students are able to learn anywhere and anytime based on their learning interest and learning style. In this case, teachers do not only play role as learning source, but also they can design a learning taking the advantage of media and learning sources to create effective and efficient learning (Sanjaya, 2012)

The progression of technology induces humans to interact each other both consciouly and unconsciously. Electronical media as the result of technology development clearly attract students' interest and have important role to the development of education. The advantage of learning activity caused by the improvement of science and technology is that students are able to seek for information and learn it by themselves. This learning means an activity conducted realistically and concretely which can enhance understanding and critical thinking. In addition, it frequently avoids verbalism.

Technology advancement can be used as learning sources meaning information provided and stored in the form of media which may help students to learn as the manifestation of curriculum (Prastowo, 2011). They can be the form of object, data, facts, ideas, or humans which can elicit learning process. This usage may help students increase their understanding and skills of a lesson. However, most teachers teach using direct learning model with preaching method without sufficient learning source facilities. Consequently it causes boredom, misperception, and unattractive learning which result in unsatisfying learning outcomes.

One of the examples of learning source is Student Worksheet. SW is a learning alternative appropriate for students since it helps them collect information related to concept through systematic learning. In learning process, SWs has been used by teachers and students (Indrianto, 1998). Based on the observation conducted in SMA Negeri 11 Makassar, the SWs used by the teachers are are quite conventional i.e. SW distributed by a publisher to teachers without the contribution from teachers such as the plan, the preparation, and the arrangement. Then, it causes the SWs unattractive and monotonous. Besides that, they don't notice the need of students.

Furthermore, the SWs may not help students in comprehending concept since they are in the form of exercises only. Based on an interview with a chemistry teacher in SMA Negeri 11 Makassar, she feels difficulty in making students comprehend the subject caused by the abundance of materials and the limited time of teaching. It then forces her to use SW as learning source in students' house to fulfill the material giving implementation.

On the basis of education research, sw simplifies students to comprehend learning material since the material is summarized and it contains exercises which helps students to understand the point of learning, simplifies the work of teachers, and stimulate students to learn. Moreover, it helps lazy students who free unwilling to read long description of material

Advantages of LKS will not be perceived by students when worksheets that have been used by students in learning is still not practical and effective. Students' sorksheet can be developed that can be tailored to students' needs and technological developments. One way to do that is to develop worksheets by using certain software, so students' worksheet more practical and effective for use in learning , both used at school and home use. A software which can be used is a *quiz creator* that can be used to create interactive worksheets.

Students' worksheet is packaged using software *quiz creator* can be used by students as a source of learning to create learning process a fun, interesting, interactive, and effective, and is expected to motivate students to learn independently, creatively, and can reduce the saturation of the students in the learning process in the classroom. Based on the above description, the necessary research to develop interactive chemistry students' worksheet using *quiz creator* program as an innovation in the world of education that utilizes the development of science and technology, especially in high school chemistry material. The research question posed in this study is that "is the developed students' worksheet valid, practice, and effective?'.

II. RESEARCH METHOD

The kind of this research was (*Research and Development*) aimed at creating teaching material in the form of interactive students' worksheet in the subject of chemistry which satisfying valid, effective, and practice criteria. The result of the developed teaching material was tested with restriction (small scale) in SMA Negeri 11 Makassar. The subject for product validation was the expert of media and chemistry material including two chemistry teachers. The subject of the test was students in grade XI MIA consisting of 20 students of which there are 8 boys and 12 girls.

The development of the interactive students' worksheet applied research and development, which refers to the ADDIE development model . ADDIE Model consists of five stages, namely analyzing, designing, developing, the implementing, and evaluating. Model development ADDIE was chosed based on its advantages i.e.: 1) it can be used as a basis for developing instructional media because of a general nature, 2) the description of the model in a more complete and systematic, making it easier for researchers to control its execution, 3) it can save time and costs, 4) in its development involves the assessment of experts, so prior the test, there are advices from the experts

The validity test of the students' worksheet was obtained from the review of two experts, meanwhile the practical test was obtained from the responses of students and teachers. During the use of the package, effectiveness test was obtained using the instrument of critical thinkng of students.

III. FINDINGS AND DISCUSSION

A. Analysis Stage

Currently students generally already have a personal computer or laptop and a smartphone, even in some schools,they require that each student should bring laptop to school. The circumstances in which students prefer to operate a computer should be utilized by teachers to obtaine learning aims and also can reduce the misuse of technology by students

The number of effective weeks which is not balanced to the number of material which should be taught makes teachers overwhelmed. Besides that, students feel difficulty to comprehend the material caused by some of the materials which are taught rapidly to fulfil the target of competency achievement and education agenda. Most of the time, students are just asked to take exercise in a worksheet which make them bored except one or two of them who pay attention to finish their exercises.

Based on the observation conducted in SMA Negeri 11 Makassar, the Students' Worksheet used by the teachers are are quite conventional i.e. SW distributed by a publisher to teachers without the contribution from teachers such as the plan, the preparation, and the arrangement. Then, it causes the SWs unattractive and monotonous. Besides that, they don't notice the need of students.

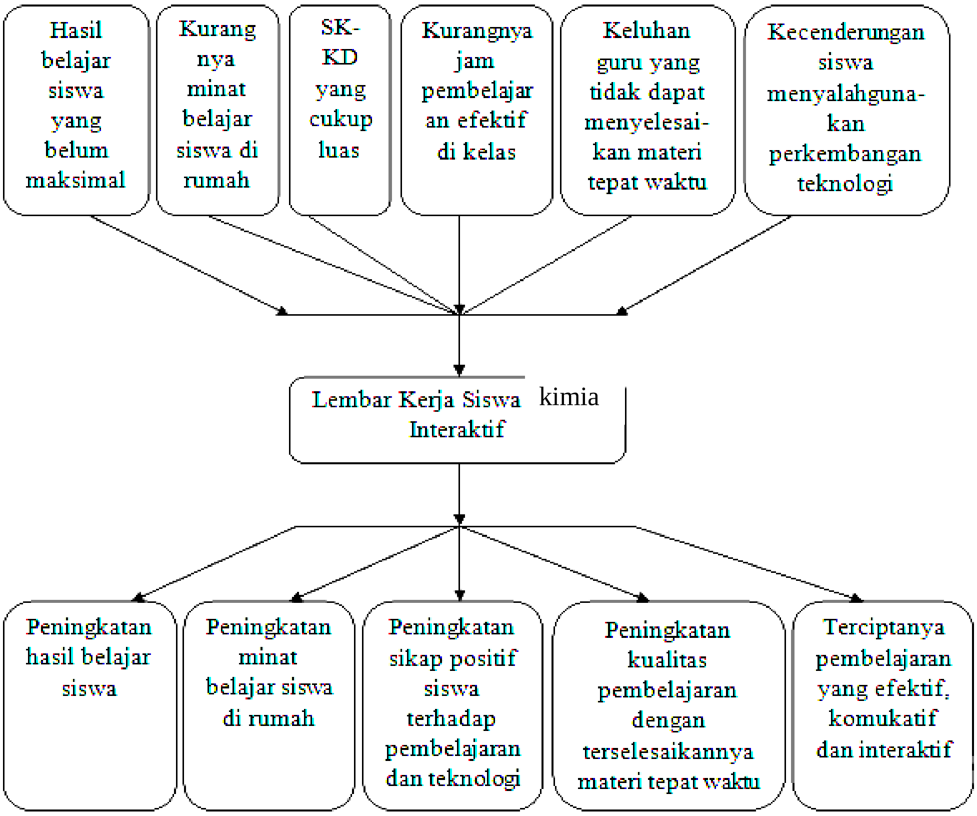

Figure 1 Analysis Diagram of the Interactive Students' Worksheet Development

Consequently, interactive students' worksheet should be developed. The interactive students' worksheet made in the form of *software quiz creator* as learning source which can motivate students is expected to solve all the problems. Besides that it can be used as reflection for their comprehending. The interactive can also solve the problem of the effective time since students can study in their houses using this students' worksheet

B. Design Stage

In this stage, the students' worksheet had been designed to cover: true false question, multiple choice with more than one correct answers, matching, ordering, *mapping*, and puzzles. The students' worksheet used *software quiz creator*.

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Before validation after validation

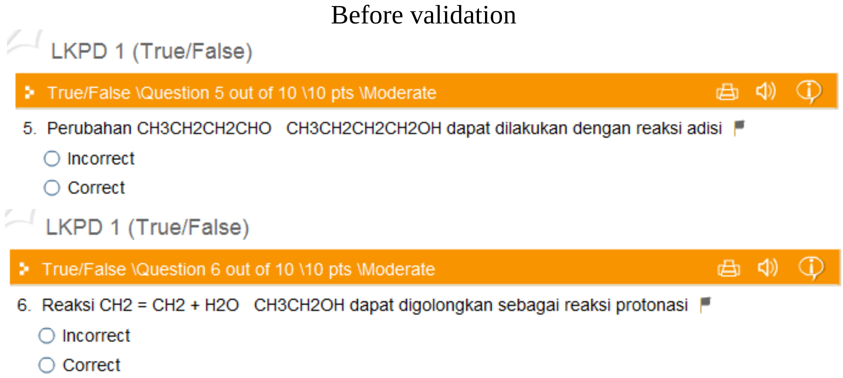
Figure 2. The Change of Guide Section of the Interactive Students' Worksheet

C. Development Stage (Students' Worksheet Validation by Expert Validator and Chemistry Teacher)

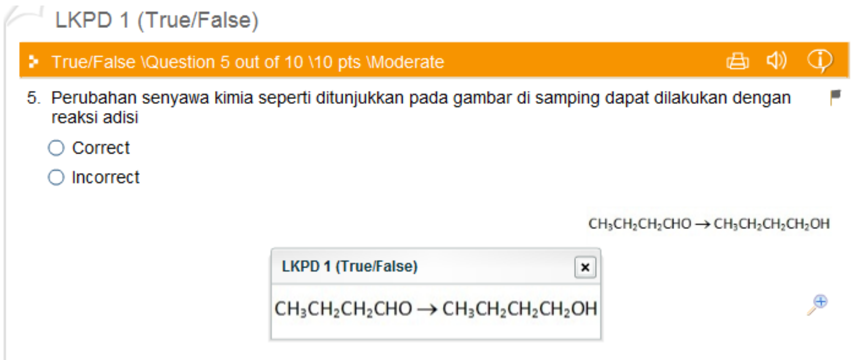
Based on the results of the validation of the experts and chemistry teacher toward true-false students' worksheet, the instruction should be revised, the sentence patterns should be altered, and the information related to the use of worksheets should be provided. The changes are shown in Figure 2 .

Besides that, there were some mistakes in the writing of chemistry formula. Then the refinement is shown in the figure 3.

Before validation



After validation



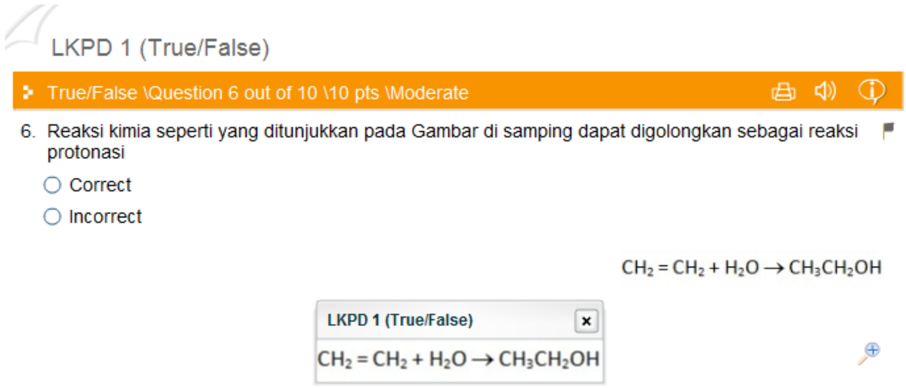


Figure 3. Change of Interactive Students' Worksheet content in the section of True-False Question

According to the suggestion from the validation result, some refinements were done shown in figure 4.

Before validation After validation

Figure 4 Change of Interactive Students' Worksheet Instruction in the section of Multiple Choices

In addition, there were some mistakes found in the form of mollecule formula writing and the use of Bahasa Indonesia aspect. The refinement is shown in the figure 5.

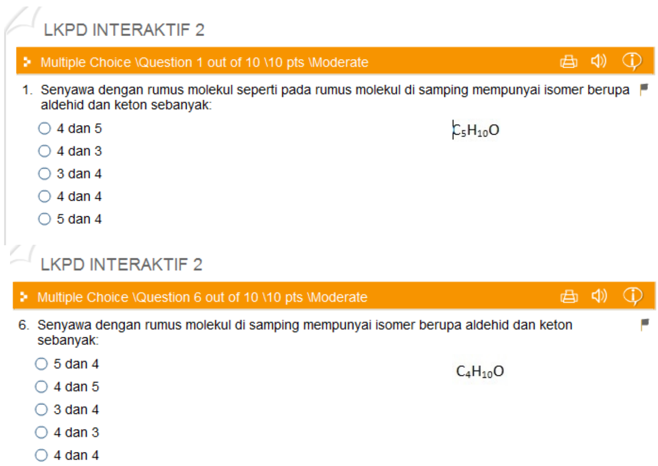
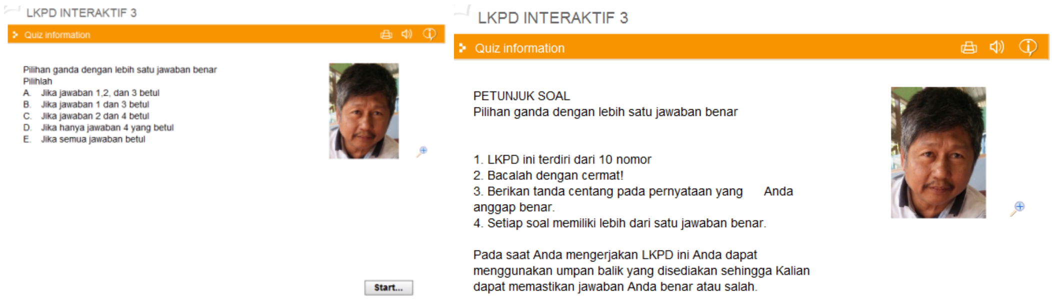


Figure 5. Change of Content in the interactive Students' Worksheet in the section of multiple choice

Based on the result of validation result, the refinement conducted to the interactive students' worksheet in the section of multiple choices with more than one answers includes the instruction in the interactive students' worksheet (Figure 6).



Before validation After validation

Gambar 6. The change of the instruction in the section of multiple choices with more than one answers

In the content of students' worksheet, it was found some shortages which should be refined. The result of the refinement is shown in the figure 7.

Before validation

After validation

Before validation

After validation

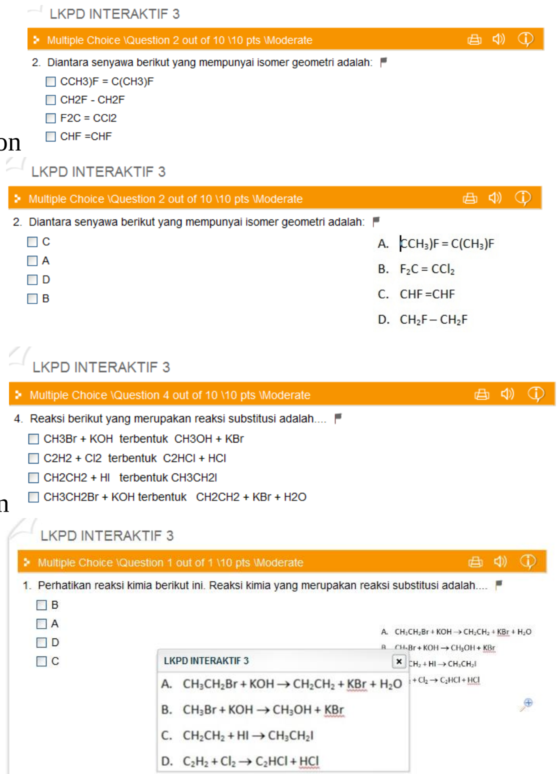
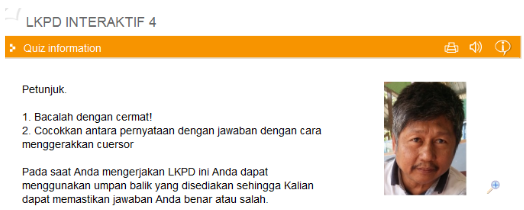


Figure 7. Change of the interactive students' worksheet content in the section of multiple choices with more than one answers

The change administered to the section of matching is related to the instruction as well as shown in the figure 8.

Before validation



after validation

Figure 8 The change of Interactive students' worksheet in the section of matching

For the other sections e.g. crossword puzzle, the validators didn't give any suggestion for the refinement. In total, the results of the validation is shown in the table 1. In the table, the interactive students' worksheet has valid category.

Table 1 The Value Average of Validation Result of Interactive Students' Worksheet in the Subject of High School Chemistry by Expert

Aspects		Form of STUDENTS' WORKSHEET						
		A	B	C	D	E	F	G
Instruction Aspect								
1	The instruction is clearly stated	4	4	4	4	4	4,5	4
2	The instruction is understandable	4	4	4,5	4	4	4,5	4
Aspect of Interactive students' worksheet								
1	Activating students	4	4	4	4	4,5	4	4
2	Simplifying students to understand	4	4,5	4		4,5	4,5	4,5
3	Simplifying teachers to give exercise to students	4	4	4	4	4	4	4
4	Being used students to independently learn	4,5	4	4	4	4,5	4,5	4,5
5	Interesting layout	4	4	4	4	4	4	4
6	There is a feedback	4	4	4,5	4	4	4	4,5
Language Aspect								
1	In accordance to Bahasa Indonesia's rule	4	4	4,5	4	4,5	4,5	4,5
2	Communicative Statements	4,5	4	4,5	4,5	4	4,5	4,5
3	Using simple language, understandable, not ambiguous	4	4	4,5	4,5	4	4,5	4,5
	Average	4,08	4,02	4,27	4,11	4,13	4,38	4,25
	Criteria	V	V	V	V	V	V	V

Description:

V : Valid
A: True-False
B: Multiple Choices
C: Multiple choices with more than one answers
D : Matching
E : Ordering
F : Mapping
G: Crossword puzzles

The results of the validation by the chemistry teacher is shown in the table 2. In the table, the interactive students' worksheet has valid cateogry.

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Tabel 2 The Value Average of Validation Result of Interactive Students' Worksheet in the Subject of High School Chemistry by Chemistry Teacher

Aspects		Form of STUDENTS' WORKSHEET						
		A	B	C	D	E	F	G
Instruction Aspect								
1	The instruction is clearly stated	4	4	4	4	4	4,5	4
2	The instruction is understandable	4	4	4	4	4	4,5	4
Aspect of Interactive Students' Worksheet								
1	Activating students	4,5	4	4	4,5	4	4	5
2	Simplifying students to understand	4	4	4	4	4,5	4	5
3	Simplifying teachers to give exercise to students	4,5	4,5	4,5	4,5	5	4	4
4	Being used students to independently learn	4	4	4,5	4,5	4,5	4,5	5
5	Interesting layout	4	4	4	4,5	4	4,5	5
6	There is a feedback	4	4	4	4	4	4,5	5
Language Aspect								
1	In accordance to Bahasa Indonesia's rule	4,5	4	4	4	4	4	4
2	Communicative Statements	4	4,5	4	4	4	4	4
3	Using simple language, understandable, not ambiguous	4,5	4,5	4	4,5	4,5	4,5	4
	Average	4,15	4,13	4,05	4,16	4,16	4,36	
	Criteria	V	V	V	V	V	V	V

Description:

V : Valid
A: True-False
B: Multiple Choices
C: Multiple choices with more than one answers
D : Matching
E : Ordering
F : Mapping
G: Crossword puzzles

D. Implementation and Evaluation

- Response of Students towards the Interactive Students' Worksheet

The results of students' response to the interactive Students' Worksheet to true-false problems in chemistry teaching in high school shows that aspects of the instructions obtained an average value of 3,68, interactive worksheets aspect with an average value of 3.83 and aspects of language with value average 3,58. The average value of the validation for true-false question in the whole aspects is 73,8 with positive category. After being validated the items in the first validation , there is one point on aspects of language which was firstly in a less positive category be positive that the response of students in making the formulation more communicative with an average value of 3,9 . So that the average value of the the validation result to the interactive questions in the form true-false questions for the entire aspects is 74,8 with positive category

The results of the students' response to the Interactive Students' Worksheet to multiple choice questions in the learning of high school chemistry indicates that aspects of instruction has the average value of 3,53, interactive worksheets aspect has the average value of 3,43 and aspects of language has the average of 3,55. The average value of the validation results of interactive questions in the form of multiple choices for all aspects is 70,00 with positive category (Attachment 16). In the aspect of interactive worksheets, there are two attractive points i.e. interactive multiple choice which can facilitate students to understand the material (3,35), interesting layout (3,30) and students' worksheet can give direct feedback (3, 05). After being revalidated several items on the first validation which is in quite positive category has become positive i.e. the interactive aspect or aspects of language. In the interactive aspect, there are three points which was in a less positive category that students' response to worksheets to facilitate the students to understand the material, presenting interesting and students' worksheet can provide feedback directly with the average value of the three i.e. 3,7 (positive). Furthermore, in the aspect of language, there are two points to be positive that the students' responses to the formulation of communicative statement and use simple language, easy to understand and unambiguous with the average value of the three, i.e. 3,75 (positive).

The results of students' response to the interactive Students' Worksheet to multiple choice questions with more than one correct answer in the learning of high school chemistry indicates that aspects of the instructions obtaines the average value of 3,43, interactive worksheets aspect with an average value of 3,29 and the aspect of language with an average value of 3,50. The average value of the validation results to the multiple choice question with one correct answer for all aspects is 68,00 which is in less positive category (Attachment 17). In the aspect of interactive worksheets, there are five attractive points, which is about interactive multiple choice with one correct answer which can activeate students (3,30), enabling the students to understand the material (3,00), students can use to learn independently (3,20), presenting interesting students' worksheet (3,45) and students' worksheet can give direct feedback (3,30). After being revalidated, several items on the first validation which is in included in less positive category become positive category, the interactive aspect or aspects of language. In the manual aspect, there are two points which was in less positive category be positive that students' response to the instructions students' worksheet clearly stated and easily understood by the average value of the two is 3.67. In the aspect of interaction there are five points that initially also less positive to positive student response tehadap namely interactive worksheets that can enable students to facilitate the students understand the material, can be used by students to learn independently, interesting layout and can give direct feedback with the average of the five aspects is 3,31. While the aspect of language, there is one point which was also in less positive to positive student response towards the formulation of communicative statement with the average value 3,2.

The results of students' response to the interactive students' worksheet of matching questions in learning of high school chemistry shows that aspects of the instruction obtains the average value of 3,53, interactive worksheets aspect with an average value of 3,51 and aspects of the language with the average of 3,57. The average value of the results of validation interactive questions in the form of matching for all of the aspects is 70,60 with a positive category (Attachment 18). In the aspect of interactive worksheets, there are three points to concen concern, namely the interactive questions in the form of matching which can facilitate students to understand the material (3,40), allows teachers to give assignments to the students (3,45) and interesting presentation (3,45). After being revalidated several items on the first validation which includes less positiv categories become less positive category in the instructions and interactive aspects. In the manual aspect, there is one point which was originally in a less positive category becoming positive i.e. students' response to the instructions worksheets that are easy to understand by the average value of 3,4. While the aspect of interactive worksheets that contained three poins which are initially in less positive category becoming positive student responses namely worksheets that facilitate students understand the material, allows teachers to assign work to students and the interesting presentation with the average value of the three i.e. 3,43.

The results of students' response to the interactive Students' Worksheet in the section of ordering in learning of chemistry in high school shows that aspects of the instruction obtains the average value of 3,48, interactive worksheets aspect with an average value of 3.53 and aspects of the language with the average value of 3,90. The average value of the results of validation in the form of interactive questions in the section of ordering of all of the aspects is 71,40 with positive category (Attachment 19). In the aspect of interactive worksheets, there are three points to concern, namely, the question in the form of ordering, students can use to learn independently (3,45), interesting layout (3,45) and students' worksheet can give direct feedback (3,53). After revalidated, several items on the first validation that is included in less positive become positive, both the student responses on the user aspect, the interactive aspect and the aspect of language. In the aspect of instructions there is one point that was in a less positive category becoming positive i.e. students' response to the instructions worksheets that are easy to understand with the average value is 3,35. In the aspect of interactive worksheets that contained three points which are initially in less category positive to positive student responses namely worksheets that students can use to learn independently, attractive presentation and worksheets can provide direct feedback with the average value of the three i.e. 3,41 , While the aspect of language, there is one point that is initially in a less positive category becoming positive i.e. the students' responses towards formulation of communicative statement with the average value i.e. 3,45.

The results of students' response to the interactive students' worksheet for mapping question in the learning of high school chemistry indicates that aspects of the instructions obtains the average value of 3,75, interactive worksheets aspect with an average value of 3,77 and aspects of language with the average value of 3,87. The average value of the results of the validation in the form of sorting questions for all of the aspects is 75,80 with positive category.

The results of students' response to thee interactive students' Worksheet for crossword puzzle item in learning of high school chemistry indicates that aspects of the instructions obtains the average value of 3,75 , interactive worksheets aspect with the average value of 3,72 and aspects of language with the average value of 3,77 . The average value of the results of validation in the form of sortin questions for all of the aspects is 75,80 with positive category.

- Data Analysis of the Interactive Worksheet

The effectiveness test was conducted to see the increase of critical thinkng skill of students N-gain in the chemistry learning using the interactive worksheet. The distribution of the skills can be seen in the table 3.

Table 3. The distribution of critical thinking skill of students

Descriptive Statistics	**The ability of critical thinking of students in experiment class**	
	Pretest	**Posttest**
Number of Sample (N)	20	20
Minimum value	21	36
Maximum value	59	81
Average	31.98	62.55
Interval	38	45
Standard deviation	12,25	12,50
N-gain average	0,45 (fair)	

IV. DISCUSSION

In this study, the instrument used is questionnaire instrument given to the validator expert, the validator practitioners (teachers) and students. The questionnaire consists of seven categories: true-false, multiple choices, multiple choices with more than one correct answer, matching, ordering, mapping and crossword puzzle. Questionnaire was used to measure students' critical thinking skills in the chemistry material. The contents of the instrument are the same for each category. The following is the description of the data analysis for each category.

Based on the data analysis of the interactive worksheets validity, the average value for the category true-false is $\bar{X} = 4{,}08$, it can be concluded that the average value from the expert validators is included in the category of "valid" ($4 \leq V_a < 5$). Meanwhile, in the multiple choice categories, the value of the average validity from expert validator is $\bar{X}$ =4,02, it can be concluded that the average value of the expert validators is included in the category of "valid" ($4 \leq V_a < 5$). For the category of multiple choice multiple answers, the average value from the expert validators is $\bar{X} =$ 4,27, it can be concluded that it is included in the category of "valid" ($4 \leq V_a < 5$). For the category of matching, the average values obtained from the expert validator is $\bar{X} = 4{,}11$, it can be concluded that it is in the category of "valid" ($3 \leq V_a < 4$). Meanwhile the average of the category of ordering from expert validator is $\bar{X} =$ 4,27, it can be concluded that the average value is included in the category of "valid" ($3 \leq V_a < 4$). Moreover, the validity of category of mapping and a crossword puzzle are respectively $\bar{X} = 4{,}38$ and $4{,}25$, it can be concluded that the average value of the expert validators are included in the category of "valid" ($4 \leq Va < 5$).

Based on the analysis of data of validity of interactive worksheets by practitioners, the average for the category true-false question from is $\bar{X} = 4{,}15$, it can be concluded that the average is included in the category of " valid" ($3 \leq V_a < 4$) . For the category of multiple-choice with more than one answers and ordering the respective average obtained from the expert validators is $\bar{X} = 4{,}13,$ 4,05 and 4,16, it can be concluded that the average is included in the category of " valid" ($3 \leq V_a < 4$). Meanwhile the category of matching , mapping and crossword puzzle, the respective average values obtained from the expert validator is $\bar{X} = 4{,}16,\ 4{,}36$ and $4{,}25$ it can be concluded that the average values is included in the category of " valid" ($4 \leq V_a < 5$).

Based on the results of data analysis of students' response to interactive worksheets for categories of right and wrong values obtained by an average of 74.8 % , for the category of 72.2 % multiple choice , multiple-choice category , with over one answers by 71.3 % , to match category of 71.1 % . to sort the category to 72.5 % . While the category mapping or map and a crossword puzzle at 75.8 % . Of these six categories , it can be concluded that the average value of students' response toward the interactive worksheets included in the positive category .

To determine the effectiveness of interactive worksheets on chemistry learning then it is conducted test of critical thinking skills of students before and after learning. From the test results, it is then calculated to determine the N-Gain increase students' critical thinking skills. Critical thinking is one of the skills that are required both in the scope of education and within the scope of the community. Within the scope of education, critical thinking skills can help students to improve understanding of the material being studied so that students do not just memorize the course material and help students to face the demands of a world increasingly challenging (Burden, 1998, Halpern 1999, McTighe and Schollenberger 1991 Toy and Ahmet, 2012). The importance of critical thinking skills is also described by Lim (2011) that critical thinking is a key element to be someone who is fully functional in a complex modern society. This is because people are able to think critically has the skills to understand, analyze and solve everyday problems.

Many experts who have defined the critical thinking among them are Dewey, the father of the tradition of critical thinking modern (1909 in Fisher, 2009), called critical thinking as 'reflective thinking' and define it as a consideration active, persistent (continuous), and carefully about a belief or a form of knowledge that is taken for granted in light of the reasons which support it and the conclusions advanced into trends. Manyer and Goodchild in Fathurrohman (2011) also defined critical thinking stating that critical thinking is a cognitive process that is systematic and active in assessing the arguments, judging a fact, assessing the wealth and the relationship of two or more objects and giving evidence to accept or reject a statement. This is in line with the notion of critical thinking by Norris and Ennis (in Fisher, 2009) that critical thinking is thinking that makes sense and reflective focusing to decide what should be trusted or do. Reflective means considering all alternatives before making a decision actively, diligently and carefully.

Table 3 shows the lowest score on the pretest results in the experiment class is 21 while the lowest score on the posttest results is 36. Furthermore, in the pretest, the highest value is 69 while the value posttest results is 81. The average value of pretest of critical thinking is 31.98 while the value of average in the posttest of critical thinking of students is 62.65 . Critical thinking test results obtained by the students can be grouped based on the value of N-gain. The average N-gain of thinking skills of students gain is 0.45 (fair category).

The improvement of critical thinking in more detail can be seen by the analysis of the normalized gain (N - gain). Analysis of N -gain functions to determine the effect of the use of the interactive worksheets to see an increase in students' critical thinking after being given treatment. Based on the table 4.1 it can be seen that the average of value normalized gain in the experimental class is 0,45. This shows an increase in critical thinking skills of students in the experimental class falls into the category of fair. The improvement of critical thinking skills that are measured in the above table is the average accumulated value of the five indicators of critical thinking skills that are measured in this study that includes focusing on the question , analyzing arguments, considering the report observations , concluding, and assessing.

V. CONCLUSION

Based on the research findings, it can be concluded that the interactive worksheet in the chemistry material which is developed to measure the critical thinking of students is valid, practice, and effective. The average of the validation done by the expert for the interactive STUDENTS' WORKSHEET in the section of true-false, multiple choices, multiple choices more than one answer, matching, ordering, mapping, and crossword puzzles are respectively: 4,08; 4,02; 4,27; 4,11; 4,10; 4,38; and 4,25. The average of the validation done by the teacher for the interactive STUDENTS' WORKSHEET in the section of true-false, multiple choices, multiple choices more than one answer, matching, ordering, mapping, and crossword puzzles are respectively: 4,15; 4,13; 4,05; 4,16; 4,16; 4,16; 4,36; and 4,25. The average of the expert validation and teachers is in valid category. For practical aspect, students give positive response for sections true-false, multiple choices, multiple choices more than one answer, matching, ordering, mapping, and crossword puzzles i.e. 74,8; 72,2; 71,3; 71,1; 72,5; 75,8; and 75,8. Moreover, for effectiveness aspect, the value of *N-gain* is 0,45 which is in fair category.

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CE – 06

The Development of Contextual Collaborative Learning Model for Chemical Bonding Course

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Abstract**—**Research about the contextual collaborative learning model for chemical bonding course has been carried out. Through this concept, the learning process is conducted by combining the conventional lecture by the lecturer and the foreign lecturer and the combination with computational chemistry. The result of cognitive evaluation test at the beginning of the course showed that the distribution of understanding of each class is not different significantly. This gives an overview that the classes consist of homogenous students, thus, the comparison could be performed objectively. The result of the evaluation test in order to understand the students' response to the perception and interest showed a different effect at two classes. This might be due to the difference of the teaching performance of the lecturers in the first and the second classes. The attendance of the foreign lecturer and the use of computational media have proven to give a positive impact for the learning process.

Keywords: *collaborative, contextual, computation, chemical bonding*

I. Introduction

Chemical bonding course is a mandatory course which is full of theory as well as philosophic concept and is closely related to physics. Thus, the learning process is often trapped in mathematical approach and not giving a clear chemistry description to the students (an example is given in Figure 1).

One of the techniques that can be developed to solve the problems above is conceptual teaching method. Basically, the conceptual method emphasizes in the enrichment of the student's basic knowledge by involving some actors in the curriculum development, for example the visualization approach of chemical bonding theory to the students[1].

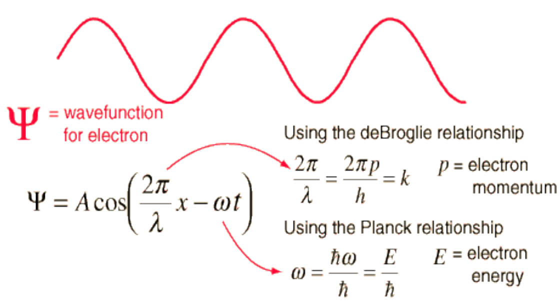

Figure 1. An example of mathematic approach in teaching materials of chemical bonding course

The visualization has a broad scope. It is not only for the theory proofing but also for the enrichment of the conceptual understanding as well as the interest of the students. According to these, computational chemistry can be adopted as one of the visualization media, thus, the improvement of the lecturer's expertise about computational chemistry is urgently needed. By combining the visualization using computational chemistry as a part of conceptual approach and the improvement of the lecturer's expertise, this research was carried out to develop the model of conceptual collaborative learning by inviting an expert lecturer from abroad.

Research Objectives

This research aims at: Understanding the effects of the attendance of an expert foreign lecturer by developing a design of contextual collaborative class and increasing the cognitive, affection and psychomotor achievements of the students.

II. Methods

Research Methods

Research was carried out at Chemistry Department, Faculty of Mathematics and Sciences of Universitas Islam Indonesia, Yogyakarta on the 3rd semester students for 6 months, starting from September 2015 to February 2016. The subject of the research is students; two classes of students to participate in the collaborative class which involves the expert foreign lecturer (for 1 week) and two classes of students to participate in the conventional teaching method as a comparison.

The curriculum team of Chemistry Department of UII has arranged a concept map for chemical bonding course as illustrated in Figure 2.

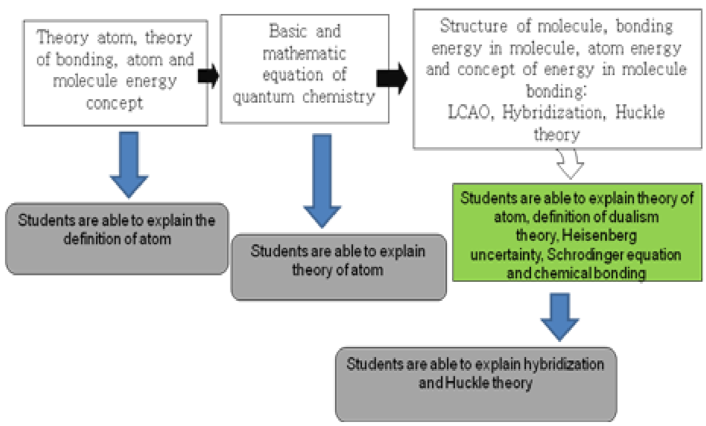

Figure 2. The concept map of chemical bonding course.

Based on the concept map in Figure 2, the development method for the learning system of chemical bonding course will be carried out in some steps:

The class evaluation which is needed for the development of the learning design for chemical bonding includes:

1. The class pre-evaluation, conducted via online system using the Computer Based Competence Evaluation (CBCE) program. It is to observe the initial knowledge of the students related to the course materials in chemical bonding course.

2. The observation of how far the utilization of computer and multimedia technology in the class are.

3. How the design of the assignments given to the students is conducted to accelerate the achievement learning target [2].

The evaluation carried out for the students is needed to group the students according to their cognitive skill.

ii. The design of the class action

The design of the class action is applied in each two classes of experiment and two classes of conventional teaching. Schematically, the design of the class action is given in Figure 3. According to the design of the class action, the information about whether the learning process given to the students will have a positive impact or not could be obtained. If the learning process gives a positive impact, the further follow-up and the development will be conducted and finally followed by the final evaluation

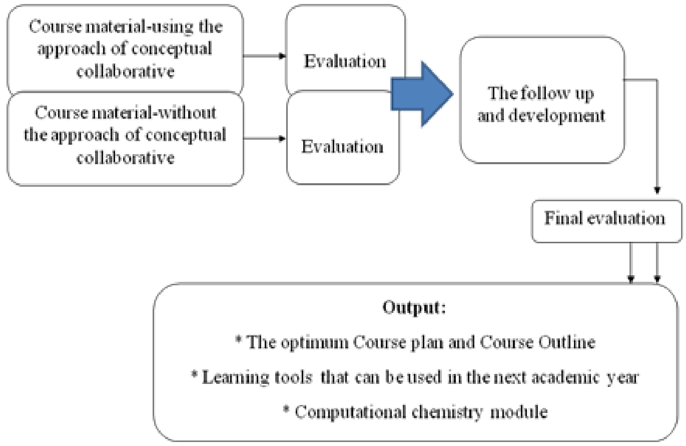

Figure 3. The design of the class action

The output of the final evaluation will be in the forms of course plan, course outline, etc.

II. Results and Discussion

The learning process using this collaborative concept aims at making it easier for the students to understand the given course. The targets and the indicators of the program are given in Table 1.

Table 1. Targets and indicators of the program

No	Indicator	Baseline	Learning achievement target
1	course plan	available-without the collaborative conceptual approach	available course plan and course outline with computational module approach
2	the availability of teaching material	available module with course plan approach	available draft of learning book with collaborative conceptual approach
3	the availability of learning tool	not yet available	available mini computer laboratory and software with learning plan approach
4	average score of students	-	increasing of average score academic students
5	score of lecture performance	3,33	>3,50

Implementation

Most of the students think that the physical chemistry course (in this case is chemical bonding course) is more difficult that the other courses [3]. Many approaches in the development of physical chemistry learning method have been conducted to increase the passion and interest of the students. The activities in each session are given in Table 2.

Table 2. The activity of the program for teaching-learning funding grant for chemical bonding course/ session

No	The activities	Significant findings	No	The activities	Significant findings
1	- The presentation about the program - Pre evaluation regarding the interest of the students to physical chemistry and	A positive respond of the students to the visualization of chemical bonding course material. This respond was shown by a 'curious character'	4	Lecture using computational method/visualizati on	Students have a positive respond regarding the activity. It was shown by the activity of each student in answering the given questions in front

	pretest related to physical chemistry I - The explanation of *course outline* - Review of physical chemistry I materials which are related to chemical bonding - Visualization materials: gas properties	of the students which cognitively is above the average of the class			of the class
2	- Classes are divided into two groups. Group I (Class A and B) was the group in which the conventional teaching method was implemented-without a foreign lecturer and the introduction to computational chemistry. - Group II (Class C and D) was the group in which the program was implemented- the presence of a foreign lecture and introduction to computational chemistry.	The first term (before midterm) of the course is given conventionally. The lecturer gives a lecture and delivers the course material using whiteboard as a media and gives an example of problem afterwards. The respond of the students which have high motivation and cognitive ability to solve the problems given in front of the class. The second term (after midterm) of the course, the students are divided into 5 groups, and each group was represented by a student to present the result of the discussion. The positive respond from the students was shown by the activity of the students to participate in solving the problems. Students are interested to the term of energy in quantum chemistry. In this term, at least 10% of the students were active in giving questions and respond	5	Conventional lecture is used to evaluate the limitation of the lecture with a foreign lecturer	
3	Classic lecture by the foreign lecturer	The respond of the students which have high motivation and cognitive ability to solve the problems given in front of the class.			

For the next step, learning session is conducted regularly by the course lecturer using scientific group as a control. In a whole, the classes consist of four groups: class A and B in which the program is not applied and class C and D in which the program is applied.

According to some questions given in the class quiz, the students can be grouped into three groups:

- The group in which tutorial is recommended
- The group in which tutorial is needed
- The group which is allowed to not participate in the tutorial

The result of cognitive evaluation in each class is illustrated in Figure 4.

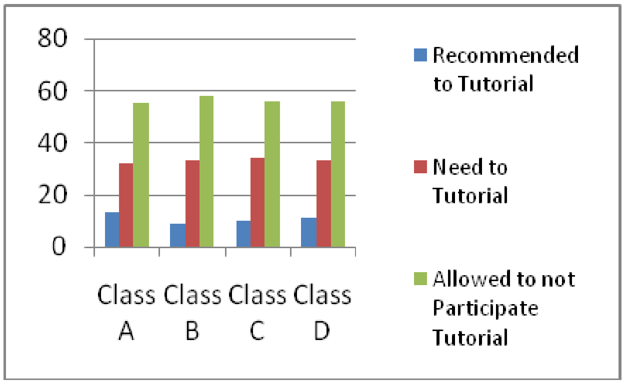

Figure 4. The result of cognitive evaluation

The evaluation for class C and D includes the cognitive and perception aspects. The evaluation grade for the cognitive and perception aspects is shown in Table 3.

In Table 3, the students give score as follows: 1: highly agree; 2: agree; 3: doubtful; 4: disagree; 5: highly disagree.

Table 3. The component for the assessment of student's interest and perception

No	Component	Explanation
1	Interest	The course material of chemical bonding is interesting for me
2	Perception	A foreign expert lecturer will help the student to learn
3	Cognitive perception	Computational chemistry will help the student to learn.
4	Cognitive perception	Chemical bonding helps the student to learn about other courses
5	Cognitive	Chemical bonding is related to computational chemistry

According to the result of evaluation in Figure 5, the program does not have a significant effect in class D. The perception score is relatively good with the value of 80%. This shows that the students have a positive perception for the program.

A unique finding is shown in the aspect of interest for question number 1: the course material of chemical bonding is interesting for me. In class C, there is a decrease of the response after the program, while in class D, there is an increasing response after the program. This indicates that the teaching-learning process that involves a foreign expert lecture gives a different effect in each class.

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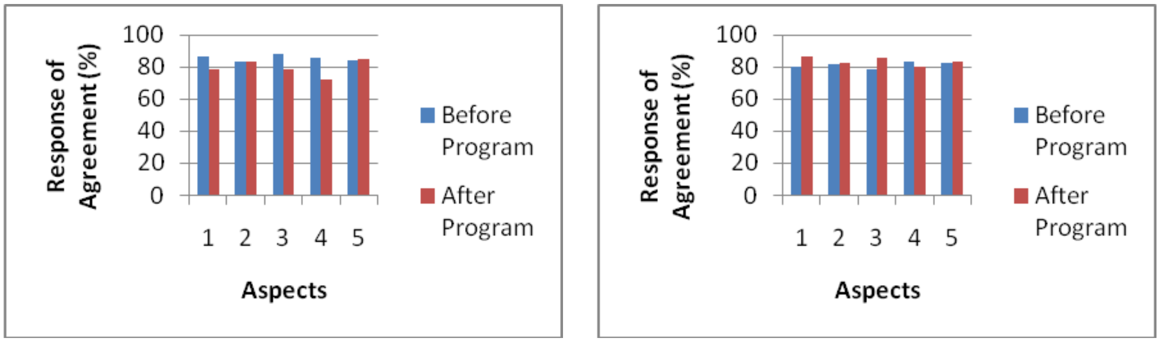

(a) **(b)**

Figure 5. The evaluation result of the perception and interest of the students before and after the program, in (a) Class C (b) Class D.

Table 4. Activity and target of the program that involves a foreign expert lecturer

No	Activity	Program Targets	Results
1	Lecture in class C and D (3 sessions)	✓ Introduction and standardization of chemical bonding course materials according to *Royal Society of Chemistry* (RSC) curriculum ✓ The observation of interest, perception and respond of the students ✓ The observation of student's activity	✓ Students are active in giving questions ✓ Students look enthusiastic
2	Lecture/Workshop in a large class (Plenary) (one session with class C and D)	✓ The observation of interest, perception and respond of the students comparatively between classes ✓ The observation of student's activity	✓ Students are active in giving questions
3	Lecture/Workshop in a large class (Plenary) (one session with class A and B)	✓ The observation of interest, perception and respond of the students comparatively between classes in which the program is applied and classes in which the program is not applied ✓ The observation of student's activity	✓ The students are active and gain a new insight in chemical bonding course given by a foreign expert lecture
4	Practical course using computer (class C and D)	✓ Introduction and standardization of chemical bonding course materials according to RSC curriculum ✓ Introduction, relation between the course and other courses ✓ Visualization	✓ Students have a clear idea about the relation between chemical bonding course and computational chemistry ✓ The availability of module which can be inserted into the suitable practical course

Table 5. The map learning outcomes and the assessed aspects

No	Learning Outcomes	Materials/Example of question	Assessed aspects
1	CP24: Apply logic, critical, systematic and innovative thinking in the context of the development or the implementation of sciences and/or technology according to student's field of expertise;	Bonding formation Example: 1. Mention three theories that become the bases for the development of Quantum Mechanics theory, please explain. 2. Explain the meaning and properties of ψ which is differentiated from the Schrödinger wave equation and the position of atom in Quantum Mechanics theory.	▪ Understanding ▪ Knowledge Students understand the development of quantum mechanics theory
2	CP 25: Draw an appropriate decision to solve a problem related to student's field of expertise, based on the analysis result of the information and data	Orbital Example: 1. Explain the steps for Schrödinger wave equation until the geometry of orbital is obtained (for example: s orbital is ball shape, etc.) 2. Why is N_2 formed while He_2 is not?	▪ Analysis ▪ Synthesis ▪ Evaluation
3	CP27: Manage the self-learning process	Quiz and assignments	✓ Knowledge: recall, remember information

III. Conclusion

The learning process of chemical bonding course can be conducted using the conceptual collaborative approach through the evaluation of the perception and interest of the students as well as the combination with other courses, especially computational chemistry. The presence of a foreign expert lecturer gave a positive impact in the teaching and learning process.

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B – 01

Microbiological Air Quality of Offices and Lecture Rooms in Yala Rajabhat University

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Abstract**—**Microbiological air quality of offices and lecture rooms in Yala Rajabhat University was investigated in Semester 1/2013 by using opened plate technique for trapping airborne microbes on plates of Potato Dextrose Agar (PDA) and Nutrient Agar (NA). For 4 equal squares of each sampling room, 4 sampling plates of PDA and NA per square were used and placed horizontally centered, and 1-meter distance from the room floor. Consequently, results showed that PDA and NA sampling plates showed different counts of bacterial and fungal growth with total bacterial count highest at 5.83 cfu/m3 and lowest at 0.23 cfu/m3. Whereas, the highest total count of fungi was 0.55 cfu/m3 with lowest value of 0.04 cfu/m3 (Room 20-805 and 09-116). Upon primary identification to detect the presence of fungal and bacterial indicators, the findings showed that Pseudomonas aeruginosa and Aspergillus sp were found in 100% of lecture rooms of building No. 5 and 9, as well as 4 office rooms. However, 10 lecture rooms of building No. 20 were 80% found fungal indicators. Bacterial indicators; P. aeruginosa, and Bacillus sp. were not detected in any of 23 rooms examined. Although the total count of bacteria and fungi were not exceeding the standard limit, the surveillance and control measures, especially for fungal contamination should be aware to ensure the safety of all room users in consistent with the expansion of the university in the future.Microbiological Air Quality of Offices and Lecture Rooms In Yala Rajabhat University

Keywords: *Air quality, Airborne fungi, Airborne bacteria, Yala Rajabhat University, Microbial indicator of air quality*

I. INTRODUCTION

Indoor air quality is one of the most important factors affecting the health and hygiene of the person, who must sniff 10 m^3 air per day and spend 80-95% in the buildings [1]. Breathing air carries microbial populations in the form called bioaerosol [2], a term refers to solid suspensions resulted from liquid droplets-solid particles mixing up. These components can be attached with viruses, fungal spore and conidia, bacterial endospores, pollen plants and plant parts [3]. Sources of indoor air biological contamination include a variety of organic material stored in the building, and air circulation from ventilation and air conditioning systems. Epidemiological findings indicated that frequent exposure to high concentration of air microbes often led to allergies, asthma, allergy to pollen [4][5], pneumonia [6] and other health effects, including infections [7]. Biological factors such as spores, fungi and mites have been involved in the complicated illness called "Sick building syndrome", whereby the patient will show a variety of symptoms and the patient becomes extremely difficult to treat until exposure to the air contamination in such buildings is completely avoided [8][9][10]. For several years, it was reported that allergic reactions to fungal spores were significantly increased among the young population including students, who became a large group having allergic. Disorders, and those allergic reactions mentioned above occurred throughout the long year with even more intense during the spring and summer [11]. Monitoring air quality in public buildings such as libraries, lecture halls, schools, etc., is therefore not only should be performed but also consistently be conducted to fulfil the purposes of assessing the concentration and types of microorganisms that affect indoor air quality. As for research on the microbiological quality of air in offices and classrooms, Yala Rajabhat University (YRU), Yala Province, Thailand, samples were collected by means of a 2-month time. Open plate sampling was placed at the center of the floor. Both facultative anaerobic and aerobic bacterial and fungal type and counts and microbial air pollution indicators; *Aspergillus*, *Penicillium* sp., *Pseudomonas aeruginosa* and *Bacillus* sp. were determined. Data obtained will be used to assess air microbiological quality standards. Consequently, YRU air quality level

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is defined and surveillance measures on the management of the office environment, laboratories and classrooms to meet the health policy, especially in the YRU shall be set forth.

II. MATERIALS & METHODS

A. Sampling and Culturing

Air samples were collected in 4 offices, including those of Faculties of Science, Technology and Agriculture, Education, Human and Social Sciences, and Management. Lecture rooms for air sampling included those of 6 rooms of Building 5, 3 of Building 9, and 10 of Building 20. These were designated as 05-203, 05-204, 05-205, 05-303, 05-307, 05-309, 09-112, 09-116, 09-117, 20-505, 20-506, 20-605, 20-606, 20-705, 20-706, 20-805, 20-806, 20-905 and 20-906. in Open plate sampling technique was used [12]. For 4 equal squares of each sampling room, 4 sampling plates of Potato Dextrose Agar; PDA (Difco, USA) and Nutrient Agar; NA (Merck, USA) per square were used and placed horizontally centered, and 1-meter distance from the room floor. Open air trapping time was 1 hour, and incubation was at 35^{O}C for 24-48 hours. Colonies appeared were counted for types and quantity per square meter air content, and identification of air pollution indicators were determined accordingly.

*B. **Identification of** P. Aeruginosa*

P. aeroginosa was biochemically and culturally identified by using Pseudomonas Isolation Agar (Sigma-Aldrich, USA) and Cetrimide Agar (Merck, USA) as suggested by manufacturers' guideline. Suspected *P. aeruginosa* was also done gram stain, lactose/glucose fermentation, nitrate reduction test, litmus milk, MR-VP test, and citrate test.

*C. **Bacillus sp. identification***

Bacillus sp. was identified by conventional biochemical methods. These included culturing onto Eosin Methylene Blue agar; EMB (Difco, USA), Gram stain, Urea test, Catalase test, Mannitol fermentation,. SIM (Indole) test, Simmon's Citrate Test, and Glycerol fermentation.

D. Aspergillus sp. identification

Aspergillus sp. was primarily identified by using macroscopic and microscopic morphological characteristics and data from the identification of simple fungi of New Brunswick Museum >> Mycology Web pages [13].

*E. **Penicilium sp. identification***

Primary identification of Penicillium sp. was also performed based on macroscopic and microscopic characteristics and contrasting with that of guideline for the identification of simple fungi, New Brunswick Museum >> Mycology Web pages >> [13].

III. RESULTS & DISCUSSION

*A. **Total count of bacteria and fungi***

From 2-time air samplings of office and lecture room in YRU, total count of bacteria and fungi was determined, and results showed that the highest bacterial counts in cfu/m^3 were of 5.79 and 5.83. Whereas, the lowest counts in cfu/m^3 were of 0.23 and 0.29. However, total fungal counts in cfu/m^3, the highest value was 0.49 and 0.55, and the lowest was and 0.06. Detailed results were shown in Figure 1 and Figure 2. Based on the standard of the Central and Eastern European [14][15], it was however not considered endangered or vulnerable level of microbial air content. This was because the detectable concentration of air bacterial and fungal composition was still lower. Such air microbial level was in Class B and lower than South Korean Standard [16] as shown in Table 2. As for observation that microbial content per room were variably different, this was considered normal as the nature and furnishing of rooms were all different. Also affected the air quality were dust collector and air circulation system [17]. Regarding to the Index of Microbial Air (IMA) contamination [15], classrooms and offices of YRU was still categorized as good quality, and in the level B (Table 3).

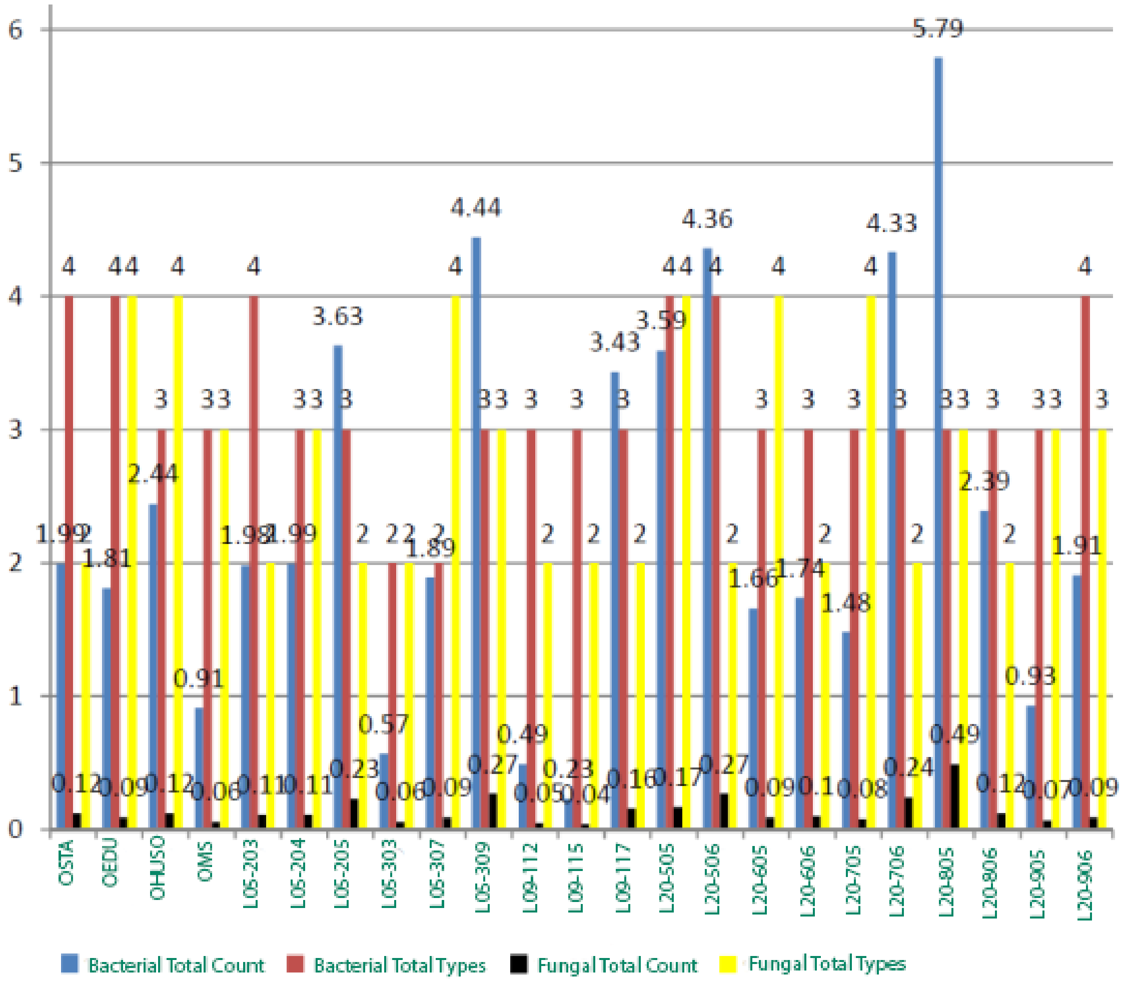

Figure 1. Counts and Types of bacteria (,) and fungi (,) in 1st investigating YRU lecture rooms designated as L for each lecture room numbers, and offices designated as OSTA, OEDU, OHUSO, and OMS for Faculties of Science, Technology and Agriculture, Education, Human Sciences, and Management Sciences, respectively.

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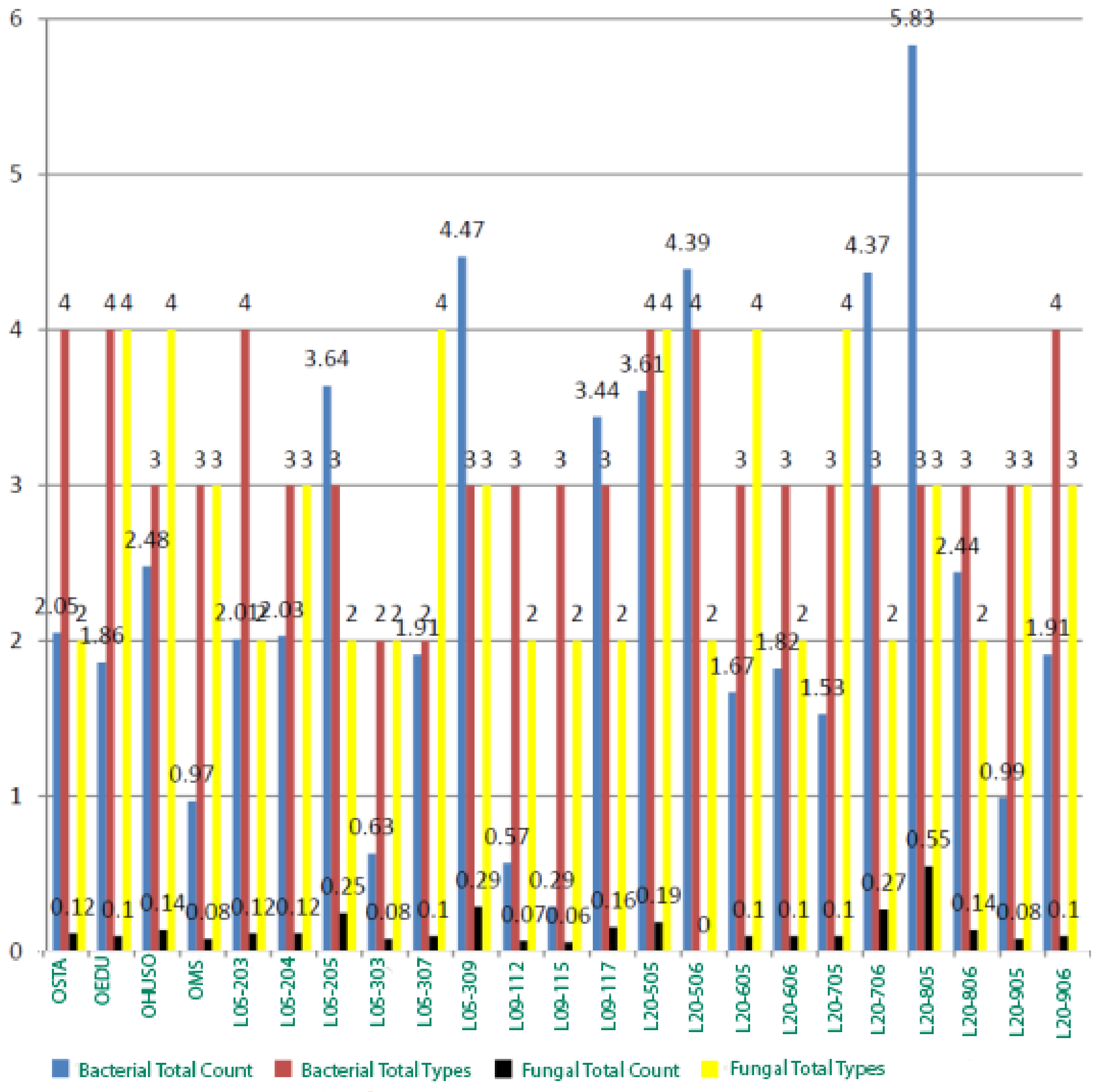

Figure 2. Counts and Types of bacteria (,) and fungi (,) in 2nd investigating YRU lecture rooms designated as L for each lecture room numbers, and offices designated as OSTA, OEDU, OHUSO, and OMS for Faculties of Science, Technology and Agriculture, Education, Human Sciences, and Management Sciences, respectively.

Table 1. Air quality levels as set by European Union Good Manufacturing Practice.

Grade*	cfu/m^3	cfu/plate†	cfu/RODAC‡	cfu/glove
A	< l	< l	< l	< l
B	10	5	5	5
C	100	50	25	–
D	200	100	50	–

* According to the EU GMP.
† Settle plates (diameter 90 mm) exposed to air during 4 h.
‡ On surfaces, RODAC contact plates, 55 mm in diameter.
§ cfu on hands wearing sterile gloves.

Table 2. Counts of air bacteria in different types of building as set to monitored by South Korea government [16].

			Hospital	Childcare center	Elderly welfare facility	Maternity recuperation center
Indoor concentration (cfu/m^3)	Total	GM	*404^{bc}	931^a	294^c	586^b
		GSD	211	611	103	284
		Max.	716	1555	408	828
		Min.	256	334	206	311
	†Respirable	GM	194^b	358^a	134^b	254^b
		GSD	78	191	29	112
		Max.	268	476	96	297
		Min.	102	97	80	115
‡Ratio (%)		GM	38.1^a	34.1^a	32.0^a	36.5^a
		GSD	16.4	20.3	14.6	18.8
		Max.	72.3	68.1	47.3	61.3
		Min.	24.6	12.8	9.2	14.2
I/O ratio	Total	GM	0.58^a	0.71^a	0.28^b	0.63^a
		GSD	0.24	0.48	0.24	0.22
		Max.	0.87	1.12	0.53	0.92
		Min.	0.32	0.43	0.10	0.36
	Respirable	GM	0.66^a	0.83^a	0.41^b	0.78^a
		GSD	0.11	0.39	0.29	0.23
		Max.	0.82	1.34	0.78	0.91
		Min.	0.43	0.52	0.21	0.45

*a, b, c means that averaged values within the row followed by the same letter are not significantly different.
†Sum of airborne bacteria concentration measured on the 3rd stage, 4th stage, 5th stage and 6th stage.
‡Value of respirable concentration divided by total concentration.

Table 3. Index of IMA and air quality [15].

IMA value	cfu/dm^2/h	Performance	In places at risk
0–5	0–9	Very good	Very high
6–25	10–39	Good	High
26–50	40–84	Fair	Medium
51–75	85–124	Poor	–
$\geqslant$76	$\geqslant$125	Very poor	–

B. Microbial indicators of microbiological air quality

In detecting bacterial and fungal indicators, *P. aeruginosa*, *Bacillus* sp., *Aspergillus* sp., and *Penicilium* sp. trapped from air samples in offices and lecture rooms, Yala Rajabhat University, results showed that both Aspergillus sp and Penicillium sp were detected in all offices and lecture rooms of Buildings 5 and 9 (100%). However, 8 out of 10 lecture rooms in Building 20 were found their presence (80%). Meanwhile, bacterial indicators were not detected in all 23 rooms. In overall results, air quality of offices and lecture rooms showed no risk of bacteria but the risk of fungal contamination with as much as 92% risk profile (Table 4). Fungal contamination in the air of buildings is considered normal as long as their counts are small and do not exceed the standards. This is because being spore producers, fungi can survive more longer than most bacteria. Although their counts are far below any standard, their presence in any circumstances should be considered as a warning signal for surveillance and cleanliness. In Eastern European countries such as Poland, air quality was immensely. Investigated, and in comparing to this research, the contamination of offices and lecture rooms was still very low (Table 5). but underestimating this condition needed to avoid [14].

Table4 . **Results of identifying microbial indicators; *P.aeruginosa* (PA), *Bacillus* sp. (BS), *Aspergillus* sp. (AS), *Penicilium* sp. (PS), in offices and lecture rooms of YRU from 1st and 2nd samplings.**

Lecture rooms/Offices	**Total detectable rooms**									
	PA		**BS**		**AS**		**PS**		**% detection**	
	1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	Bacteria	Fungi
Offices of the faculties (4)	0	0	0	0	4	4	4	4	0	100
Building 5 (6)	0	0	0	0	6	6	6	6	0	100
Building 5 (3)	0	0	0	0	3	3	3	3	0	100
Building 5 (10)	0	0	0	0	8	8	8	8	0	80
Non-detectable rooms	0	0	0	0	21	21	21	21	0	80
% Detectable rooms	0	0	0	0	91.3	91.3	91.3	91.3	0	92

Table5 . Counts (cfu/m3) of air bacteria and fungi in Upper Silesia conurbation, Poland [14].

Type of premises/microorganisms	Range	Median	Mean	Standard deviation
Dwellings [14, 17]				
Gram-positive mesophilic bacteria	88–3442	409	602	563
Gram-negative mesophilic bacteria	0–228	35	51	53
Thermophilic actinomycetes	0–627	0	12	81
Fungi	2–1997	78	189	351
Total indoor microflora	90–3445	647	854	682
Offices [25, 27]				
Bacteria	112–956	272	295	N/A
Fungi (summer)	50–1689	136	245	N/A
Fungi (winter)	18–109	53	49	N/A
Moldy homes [24, 27]				
Bacteria	178–4751	1100	980	N/A
Fungi (summer)	103–16968	504	834	N/A
Fungi (winter)	49–3852	239	256	N/A

N/A - not available.

IV. CONCLUSION & SUGGESTION

Microbiological air quality of 4 faculty offices and 6, 3, and 10 lecture rooms in Buildings 5, 9, and 20 of YRU was in good or B level according to Index of Microbial. Air (IMA) standard of the Central and Eastern European countries, ncluding South Korea. Results of the air bacteria counts in cfu/m^3 were in the range of 0.23 and 0.29 to 5.79 and 5.83. Whereas, counts of fungi in cfu/m^3 were in the range 0.04 and 0.06 to 0.49 and 0.55. Indicators of contamination hazards defined as *P. aeruginosa* and *Bacillus* sp. were not detectable, but *Aspergillus* sp., and *Penicillium* sp. were detectable 21 out of 23 rooms, accounted for 92%. This was a reflection of the cleanliness level. Although faculty offices and lecture rooms were possible to be considered clean, surveillance and care in organizing and managing office and lecture room tools and furnishers to avoid the accumulation of fungal habitats and spores was still extremely important as some types of mold was considered as allergens and carcinogens.

Microbiological air quality in lecture rooms and offices in YRU should regularly monitored by using efficient and reliable techniques. Conventional techniques that have been used in this research have limitation. Numbers of other techniques are expected to be used in the future to validate the results.

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B 2

Recruitment And Ability Of Seed And Propagule To Grow In Mangrove Forest Segara Anakan Cilacap

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Abstract— Segara Anakan mangrove forests are formed in the estuary of Segara Anakan, Cilacap enclosed by Nusakambangan Island. The forests area was 26 thousand square kilometers. In the last three decades the forests was damage due to illegal logging so that the forest area is covered by mangrove shrub of *Derris heterophylla* and *Acanthus illicifolius*. The proportion of mangrove trees is very low compared to mangrove bushes. If this situation continues, the diversity of mangroves in Segara Anakan will decline rapidly. This study aims to calculate seed and propagules production and assess the success living rate of 13 mangrove species in Segara Anakan. Purposive sampling method was applied in the data collection that was conducted in March, June, August, and November 2013. At each tree sample it was counted number of seeds and propagules, number of seedling and sapling. Descriptive statistics were used to analyze the differences between species. Results showed that each species has a different productivity of seeds and propagules, as well as the level of seedling recruitment and or sapling. Among the 13 studied species, *Bruguiera gymnorhiza, Bruguiera parviflora, Rhizophora mucronata, Xylocarpus molucensis, Ceriops tagal, Soneratia molucensis, Avicenia alba,* and *Nypha fruticans* have high productivity of seeds and propagules and good sapling recruitment. Meanwhile *Rhizophora apiculata, Aegiceras corniculatum*, and *Soneratia alba* have good productivity of seeds and propagules but it has a bad sapling recruitment. *Derris heterophylla* and *Acanthus illicifolius* in this study demonstrated the ability of the good seeds and propagules productivity but have low sapling recruitment. Based on these results it is concluded that most of the mangrove trees in Segara Anakan have high productivity of seeds and propagules and good sapling recruitment so that they have the ability to naturally restore the mangrove forest structure as long as the factors that damage the natural conditions can be minimized.

Keywords: *recruitment, mangroves, propagules, seedling, sapling, natural recovery*

I. INTRODUCTION

Mangroves are recognized as ecoton for connecting terrestrial ecosystems with marine ecosystems. Its vegetation has a unique structure (Lugo, 1974) because of its ability to function in environments with high salinity while at the same time have a high primary productivity. Mangrove ecosystem consisting of a compartment below the ground surface that consists of mud, roots of mangrove, mangrove floor fauna such as crabs, snails, worms; and compartment above the soil surface that consists primarily of mangrove trees with fauna that live in it like birds, worms, insects and reptiles. Primary energy comes from the sun, mangrove forests, and nutrients that come from the overflow of the river or the results of rainwater overflow (run-off). In this system two compartments are connected by a rotation through photosynthesis energy. Primary productivity of mangrove forests are in the form of leaves, branches, flowers and seeds that will fall to the ground and grow or eaten by mangrove floor fauna for further mineralized and returned to the ground. Many studies have been done to calculate the productivity of mangrove. Alongi (2001) stated that mangrove productivity reaches 300-400 t DW/ha. This productivity varies among species, location and season. *Avicenia marina* produce 6200 g DW/ha/year, *Rhizophora stylosa* produce 9650 g DW/ha/year and *Ceriops tagal* produce 6750 g DW/ha/year (Bunt, 1995). Primary productivity of mangrove forests in mono-specific forest is much lower than mixed vegetation forest (Twilley, 1986).

Mangrove ecosystems are also rich in fauna that help to build the forest structure on the floor of the mangrove. Mangrove crabs of the family Gecarcinidae, Ocypodidae and Sesarmae have a primary function to process the leaves and twigs that fall to the mangrove floor (Robertson 1986, 1989; Dahdouh-Guebas, 1998; Lee, 1998; Bouillon et al., 2002; Nordhaus et al., 2006). *Parasesarma leptosome* of the family Grapsidae and *Aratus pisonii* of family Sesarmidae apparently also likes to climb trees and eat mangrove leaves that still fresh (Linton, 2007). Mangrove crab floor helping the processes of decomposition of mangrove leaves. Nevertheless, crabs also eat seeds or propagules of mangrove fell to the floor. Not only that, some crabs even eat mangrove seeds that begin to grow into seedlings or saplings (Smith, 1987). Several studies have shown that the rate of consumption of the seeds or propagules by mangrove crab is much higher in the shade compared to open or hot spot. However, Imgraben (2008) found that mangrove propagules consumption by crabs is not significant. Further, Kraus (2003) found that predation of mangrove propagules by crabs is only 17% and did not differ between the shade and open place.

In addition to its unique structure, mangrove forests also have a very important function. Almost all of the fish that live in the open sea, coming to the mangrove areas which have brackish water and oxygen-rich to lay eggs and raise their offspring among the mangrove vegetation. Marsh birds such as coax night, grouse, herons, and kingfisher utilize mangrove areas for nesting and foraging. Mullet, shrimp and prawns into are source of income for fishermen in the mangrove areas. Structure of mangrove forests that have strong roots, both pneumatophore and roots and roots hanging knee proved to be a catastrophic tsunami breakwater (Dahdouh- Guebas , 2005).

Similar to other ecosystems, mangrove ecosystems are highly vulnerable to disturbance. Natural disturbances by insects apparently affect nutrient turnover in the mangrove forests of Belize (Feller, 2002). When attacked by a mangrove twig borer insect, quantity and quality of litter that falls to the floor mangrove changed. Similarly, disruption due to logging gaps or cracks also formed the beginning of the process of secondary succession in mangrove ecosystems (Das, 1985; Djohan, 2007). The results of several research studies indicate that the invading species, spread only when there is a breakdown of mangrove ecosystems (Biswas, 2007). Chronic disorders of the Sundarban mangrove ecosystem in India and Pakistan have significantly changed the composition of mangrove species and mangrove forest structure (Ameen, 1999; Biswas, 2003). Further studies showed that changes in abiotic environmental conditions after disturbance can alter species composition, species ability to withstand disturbances and recruitment patterns or the success of seeds and propagules grow into a seedling and sapling. (Baldwin, 2001; Clarke, 2000; Clarke, 2001; Piou, 2006).

Natural damage due to storms or lightning that create gap or gaps in the canopy of mangroves is not too threatening the sustainability of mangrove, whereas anthropogenic damage or damage caused by human activities in general have very bad consequences on the mangrove ecosystem. Most of Indonesia's mangrove forests has been damaged by illegal logging continuously by humans. Bruguiera or tancang group is the most hunted mangrove trees to be cut down because the quality of the wood is straight and hard. Then when Bruguiera has finished, Rhizophora is an option target group. Rhizophora though is not as straight as Bruguiera but has a hard wood. People use Rhizophora wood to make charcoal. Therefore both the mangrove family became the most threatened genus.

Mangrove in Indonesia is one of the richest mangrove ecosystems in the world. It consists of 59 mangrove floral and more than 50 mangrove fauna, which covers an area of 3.8 million hectares (Burbridge, 1982). However, most of them are in thread. For example, the proportion of *Bruguiera spp* of mangrove ecosystem in Segara Anakan Cilacap is very worrying. *Bruguiera sexangula* and *Bruguiera parviflora* are almost extinct or highly endangered. *Rhizophora apiculata* also constantly hunted by man, while the presence of *Rhizophora mucronata* is less than 5 trees per hectare. *Avicenia alba* and *Avicenia marina* are eventually also the subject of illegal logging. Similarly *Soneratia alba* and *Soneratia caseolaris*, the latter species is known as the fruit of Sonneratia that is almost extinct. And above of all *Xylocarpus granatum* and *Xylocarpus molucensis* are also highly endangered, due to the limited number of seeds compared to other mangrove trees. On the contrary, there are several species of mangroves that have been very dominant for two decades in the Segara Anakan area. *Derris heterophylla* or in local language called gadelan grow rampant in almost all regions. This species became dominant because of the opportunity to get open space (gap) from the cutting of mangrove trees that originally covered the whole forest canopy. In addition *Acanthus illicifolius* or drujon grows quickly. This mangrove shrub is easy to grow in areas that are open and often get fresh water supply. Drujon and Gadelan grow together into a dominant shrubs and lianas in the Segara Anakan.

Nypha fruticans tree that is the only mangrove palmae family that lives today in Segara Anakan is also rampant in almost all regions. Its seeds are many and their high ability to multiply vegetatively makes *Nypha fruticans* is one dominant species in the mangrove forest area that was badly damaged by continuous logging.

Scientifically we ask: Is it possible that mangrove saplings in Segara Anakan restore itself naturally? Could mangrove trees are left at this time restore the mangrove forest structure with seeds and propagule it generates ? Is it possible that mangrove seedlings and sapling grow well in the middle of Drujon and Gadelan dominance compete with them? Therefore, this study aims to calculate the seeds and propagules production of 13 mangrove species, and to assess the ability of the seeds and propagules to grow (recruitment) become seedlings or saplings in a span of 2-12 months.

II. METHOD

This research is a descriptive research conducted in Segara Anakan Cilacap. Data collection was done by applying purposive sampling method through field observations in March, June, August, and November 2013. Subject of this research is 10 mangrove tree species highly threatened and 3 mangrove species whose populations are relatively abundant. These mangrove species are 1) *Bruguiera gymnorhiza* (Tancang Merah), 2) *Bruiguiera parviflora* (Tancang Ngaglik), 3) *Rhizophora apiculata* (Mangrove Peanut), 4) *Rhizophora mucronata* (Mangrove Pendulum), 5) *Xylocarpus molucensis* (Nyirih), 6) *Ceriops tagal* (Tancang Aneh), 7) *Aegiceras corniculatum* (Gedangan), 8) *Soneratia alba* (Bogem), 9) *Soneratia molucensis* (Pidada), 10) Avicenia alba (Api-api), 11) *Nypha fruticans* (Nipah), 12) *Derris heterophylla* (Gadelan), and 13) *Acanthus illicifolius* (Drujon)

The sample included 5 individuals of each species. Each individual is measured tree height, stem diameter, wide canopy, number of seeds and propagules, number of seedling and sapling. Descriptive statistics were used to analyze differences in the parameters between species and over time.

III. RESULT AND DISCUSSION

Overall, the data of the observation is displayed in Table 1 at the end of this paper. This includes the production of seeds and propagules, the ability of seeds and propagules to grow become seedlings and saplings in a span of 2-12 months. In calculating the ability of seeds and propagules to be seedlings, the available data were not always appropriate to be used to portray the actual conditions. For example, the observation of *Bruguiera parviflora* in March found 8431 seeds and 3 propagules; in June found of 3423 propagules; in August discovered 2104 propagules, 5 seedling, and 16 sapling; then in November found 2310 seeds, 2 seedling, and 129 sapling. This data can be used to describe the production of seeds and propagules as well and the growth rate of the seeds and propagules to be a sapling, but cannot be used to describe the level of life (survival) of seedlings into sapling. This is apparently due to the observation time interval was too long so it did not fit with the timing of growth and development of propagules and or seedlings into sapling. Therefore, in the description and discussion of each species, understanding of recruitment is more related to the growth of seeds and propagules to be sapling.

1. *Bruguiera gymnorhiza* (Tancang Merah)

Observed mangrove tree height ranged from 3.10 - 4.85 m with a mean of stem diameter of 18.6 cm and canopy area of 6.292 m^2. In March the five tree yielding seed as much as 1983 (with an average of 396.6 per tree), which then in June has been discovered 403 propagules and 28 seedlings. On a visit in August it was found 345 propagules, 55 seedlings and 16 saplings. Observations in November found 819 seeds and 17 saplings. This mangrove species has very high ability in seeds and propagules production, and the growth of seeds and propagules to become seedlings and saplings is high also. In comparison of sapling number to the number of seeds or propagules, it may be very low with a percentage of less than 1%, but this sapling reached 33 individual, which is quite high compared to other species. Thus the ability of natural regeneration can be expected for population recovery in a relatively quick time.

2. *Bruguiera parviflora* (Tancang Ngaglik)

The tree height of observed five Tancang Ngaglik ranged from 3.39 to 5.49 m with an average of trunk diameter of 10.6 cm and the mean canopy area of 9.438 m^2. In March the five trees produced 8431seeds and 3 propagules and then the number of 3423 propagules were found in June. On a visit in August it was found 2104 propaguls, 5 seedlings and 16 saplings. Total sapling and seeds found in November reached 129 and 2310 respectively. Like Tancang merah, Tancang Ngaglik have very high production of seeds and propagules. Similarly, the ability to grow of seeds and propagules to become seedlings and saplings was very high also. The total saplings that survive were the highest compare to other species. It can be said that its natural regeneration ability is the best.

3. *Rhizophora apiculata* (Bakau Kacang)

This species had tree height ranges between 5.81 - 9:16 m with the average diameter of 18.6 cm and the mean canopy area of 14.70108 m^2. Observation in March found 11856 seeds, which then grows into 3725 propagules in June and 5376 propagules in August. *Rhizophora apiculata* have very high seed and propagules production, however, the ability to grow seeds and propagules to become seedlings can even be said to be very low to zero. In the four-times observation it was not found any seedling or sapling. Among thousands of seeds and propagules production there was none that could grow into a seedling or sapling. As a consequence, it is very difficult to expect that regeneration of this species can occur naturally in the short term without human intervention. This happens probably because environmental conditions are not suitable anymore for seedling or sapling growth. In the long-term natural regeneration can still be expected would happen when other species that have higher regeneration ability to grow and develop sapling properly so as to facilitate the growth and survival seedling or sapling of *Rhizophora apiculata.*

4. *Rhizophora mucronata* (Bakau Bandul)

Observed five Mangrove trees had diameter ranges from 13-51 cm with stem height varied between 3.89-5.53 m^2. The mean area of the canopy reached 6.1180 m^2. Survey found 595 seeds in March, and 151propagules in June, 24 seedlings in August, and 11 saplings in November. This mangrove has a capacity of seed and propagules production is much lower than mangrove of *Rhizophora apiculata*, but the ability to grow seeds and propagules into seedlings and saplings is much better. Although the number of survived sapling is not as many as of Bruguiera, its natural regeneration is good enough so that it can grow and flourish at the present condition.

5. *Xylocarpus molucensis* (Nyirih)

Mangrove Nyirih has tree height variations ranging from 3.04-6.74 m with the canopy average of 20.0860 m^2. In March and June observations found no seed, propagules, or seedling, but the later observations found 733 propagules and 15 saplings in August, 14 sapling and 117 seeds in November. *Xylocarpus molucensis* has relatively low seed and propagules production, but it has very high the ability to grow seeds and propagules into seedlings and saplings. The presence of 14 saplings at the end of observation (November) showed the ability of this species in its natural regeneration is quite successful.

6. *Ceriops tagal* (Tancang Aneh)

Tancang Aneh height was varied from 2.67–5.04 m with the average trunk diameter of 5.6 cm and a broad tree canopy of 5.6840 m^2. Observations found 1303 seeds in March, then 2308 propagules in June. It was found 1010 propagules, 12 seedling, and 29 sapling in August, and further observation in November found 69 sapling and 384 seeds. From these data it can be seen that *Ceriops tagal* has a pretty good production capacity of seeds and propagules. The ability to grow seeds and propagules to become seedlings and saplings is very good. Thus, this species can be expected to be able to recover the total population as early population before destruction. Of course this can happen only when the factors that support the destruction can be minimized or eliminated.

7. *Aegiceras corniculatum* (Gedangan)

Aegiceras corniculatum has very high seed and propagules production capacity, but it has a very low ability to grow seedlings. Produced thousands of seeds and propagules are not able to grow into a seedling. In the four-time observations it was found one sapling only. In March survey found the seeds of 2882, and then later 2415 propagules were found in June and 1215 propagules were found in August. In November observation found 6344 seeds and 1 sapling. The observed trees of Gedangan have varied height of 3.07 to 3.56 m, with trunk diameter of 11-28 cm and the average of tree canopy reaches of 9.03 m^2. Based on this data it can be said that it would be very difficult to expect the regeneration of this species can occur naturally in the short term. This happens probably because the environment condition is less suitable for the growth of seedling or sapling. In the long-term natural regeneration can still be anticipated that it would happen when other species that have higher ability to grow and develop properly its seedling and sapling are already established so it can facilitate the growth and survival of seedling and sapling of *Aegiceras corniculatum*. This regeneration need to be enhanced by human intervention in various forms, such as nurseries and replanting.

8. *Soneratia alba* (Bogem)

The spotted Bogem trees had stem diameter varies from 14 cm to 63 cm with height of between 4.75 - 7 m. Its mean canopy area was 47.37 m^2. Mangrove seed production of this species is very little compared to other species. Observations found only 108 seeds in March, 39 propagules in June, 31 propagules in August, and 9 seeds in November. These data indicate that the ability of *Soneratia alba* in seed and propagule production is relatively low, and the ability to grow seeds and propagules into seedlings is also very low. Almost a year observations has not found any seedling and sapling. This data also shows that without active conservation population of this species will continue to decline.

9. *Soneratia molucensis* (Pidada)

Mangroves of *Soneratia molucensis* have relatively better productivity than *Soneratia alba*. Five trees that were observed had tree height varied between 6.1-9.8 m and stem diameter between 14-67 cm with a mean canopy reached 30.66 m^2. On the several visits it was found 84 seeds in March, 320 propagules and 2 seedlings in June. The next observation discovered 85 propagules in August, and then 307 seeds and 11 saplings in November. Based on the results of these observations it can be said that Pidada has the sufficient ability of seeds and propagules production. Similarly, the ability to grow seeds and propagules into seedlings and saplings is very good. Its natural regeneration will be able to restore the population has been reduced due to destruction.

10. *Avicenia alba* (Api-api)

Avicenia alba that also known as Api-api have tree height varied 6.34 to 8.58 m with a mean stem diameter of 60 cm and a broad tree canopy of 42.858 m^2. Observations recognized 10736 seeds in March, then none in June and August, found 51 saplings, 16 seedlings, and 438400 seeds in November. This mangrove has very high ability in seeds and propagules production, and relatively low ability to grow seeds and propagules to become seedlings and saplings. Looking at these data it is clear that almost certainly *Avecenia alba* are able to regenerate naturally with success, the population increase will take place continuously in current condition as long as no significant interferences.

11. *Nypha fruticans* (Nipah)

Nypha fruticans also called nipah have tree height of 4.60-6.05 m with the average stem diameter of 90.6 cm and a broad tree canopy of 16.4540 m^2. It was found 498 seeds and 265 propagules in March, 178 propagules in June, 116 propagules in August, and further found 11 Sapling, 180 seedlings and 173 seeds in November. This species has relatively low capability of mangrove seeds and propagules production, but it has very high ability to grow seeds and propagules into seedlings saplings. This members of the family Palmae seems to be appropriate with the conditions of Segara Anakan Cilacap so that it can grow and develop properly. Its natural regeneration take place very quickly, especially in the month of November.

12. *Derris heterophylla* (Gadelan)

Derris heterophylla or gadelan has a height of 0.7-1.5 m with the average diameter of of 2.392 cm and the tree canopy area less than 1 m^2. Investigation discovered 24 seeds in March, 28 propagules in June, 10 propagules, 5 seedlings, and 5 saplings in August. Further study in November found 15 seeds only. This indicates that Gadelan has low capability of seed and propagules production, but relatively high ability to grow seeds and propagules to become seedlings and saplings.

13. *Acanthus illicifolius* (Drujon)

This mangrove is also known as drujon by local communities. It has plant height of 1.557-1.928 m with the average stem diameter of 1.244 cm and mean tree canopy less than 1 m^2. Seeds are known in March amounted to 1 , then in June found 10 propagules . In August found only 61 propagules , and further in November found 60 pieces of it. *Acanthus illicifolius* has relatively low capability of seed and mangrove propagules production, and the ability to grow seedlings saplings is also very low.

Based on the description per species that include seed and propagules production, the ability to grow seeds and propagules to become seedlings saplings in the span of 2- 12 months, the studied 13 species can be grouped into two, namely as follow:

The first group is the species that are capable of producing seeds and propagules which then grow into seedlings and or saplings. This group includes *Bruguiera gymnorhiza, Bruguiera parviflora, Rhizophora mucronata , Xylocarpus molucensis, Ceriops tagal, Soneratia molucensis, Avicenia alba, Nypha fruticans* that have seeds and propagules productivity and good sapling recruitment. This species are able to regenerate naturally on the current habitat conditions so that without any intervention the species will survive. It will be able to increase individuals in their habitat even though some of them may run slowly. However, this can happen only if the condition of the habitat can be maintained as it is today, or even better improved. If habitat destruction due to logging and land use conversion is still continue, the rate of natural regeneration of the mangrove trees would not be able to increase the population because the rate of cutting trees is greater. As consequences, the ability of natural regeneration will be further reduced or even disappear altogether.

The second group is the species that are capable of producing seeds and propagules but it will not to grow into seedlings and or sapling. This group includes *Rhizophora apiculata, Aegiceras corniculatum*, and *Soneratia alba*. It has good productivity in seeds and propagules, but it has a bad sapling recruitment. Species of this group seems to have lost the ability of seedling recruitment and growth of propagules or sapling in current habitat now. This occurs because environmental conditions today are no longer suitable for seedling and or sapling growth. Without human intervention this species will not be able to survive the current habitat condition, even just waiting for extinction. Moreover, if the ongoing habitat destruction continues, the extinction will be faster. In order to facilitate the regeneration of these species, some activities can be done, such as nursery to grow seedlings and propagules into a sapling in their natural habitat or elsewhere as appropriate. Then do the planting sapling that has grown in its original habitat or in places that have a certain suitable conditions to grow and thrive. To realize, the information related to this case in more detail needs to be known in advance. Therefore, research on the factors that influence recruitment or growth of seeds or propagules and seedlings or sapling becomes important and needs to be done.

Derris heterophylla and *Acanthus illicifolius* in this study demonstrated the good ability of the seeds and propagules productivity, but low sapling recruitment. These data also indicate that in fact the two species is the relatively weak competitors. Both of these species can grow and thrive in mangrove communities perhaps precisely because there are no competitors. As noted upfront (Djohan , 2007), *Derris heterophylla* and *Acanthus illicifolius* present immediately after the mangroves land were converted into shrimp ponds and then abandoned when the shrimp farms experienced bankruptcy. The absence of mangrove trees on former shrimp farm that is open appears to be the ideal conditions for the growth of both species that are often referred to as Gadelan and Drujon. If initiation of mangrove trees on this land is facilitated, for example by planting and maintaining, I am sure that sooner or later mangrove trees community will be back to earlier states. Examples of mangrove rehabilitation project on the coast of Bali, Probolinggo beach, Opak estuaries in Kretek Bantul, and Muara Angke Jakarta have proved it.

IV. CONCLUSION

Based on the description and discussion of the results, it can be concluded that the thirteenth of the studied species can be grouped into two based on the ability to produce seeds, propagules, seedling and sapling.

• Cluster of *Bruguiera gymnorhiza, Bruguiera parviflora, Rhizophora mucronata, Xylocarpus molucensis, Ceriops tagal, Soneratia molucensis, Avicennian alba,* and *Nypha fruticans* have seeds and propagules productivity and high Sapling recruitment. These species are capable of regenerating naturally on current habitat conditions so that they are able to add individual in the population even though some of them may be going slow. This can happen only if the condition of the habitat can be maintained as it is now, or even improved for the better.

• Cluster of *Rhizophora apiculata, Aegiceras corniculatum,* and *Soneratia alba* have good productivity of seeds and propagules but it has a very low sapling recruitment. These species seem to have lost the growth ability of propagules to be seedling and or sapling in their current habitat. This happens because the current environmental conditions are not suitable for seedling or sapling growth. Without human intervention most likely this species will not be able to survive, even just waiting for extinction.

Regeneration of these species should be facilitated to grow propagules into seedling and sapling, and then do replanting sapling that has grown in its natural habitat or certain places that have suitable conditions for sapling to grow and thrive.

• *Derris heterophylla* and *Acanthus illicifolius* in this study demonstrate the good ability of the productivity of seeds and propagules but have low sapling recruitment. Therefore, in order to bring back the community of mangrove trees on the land that has been dominated by the two species, it is essential to do planting mangrove trees in that land and then taking care of them until the plants are capable of producing seeds and propagules.

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Table 1. The number of seeds, propagules, seedling and sapling species generated by mangroves in Segara Anakan Cilacap March- November 2013

Species name (local)	Spesies Code	Plant height (cm)	Plant diameter (cm)	Canopy area (cm2)	March		June		August			November		
					seed	Propagule	propagule	seedling	propagule	seedling	sapling	seed	seedling	sapling
Bruguiera gymnorhiza (Tancang merah)	Bg 1	436	13	72800	176	0	16	0	0	0	0	60	0	0
	Bg 2	485	50	93600	204	0	19	0	14	20	0	8	0	0
	Bg 3	310	7	61200	105	0	22	1	31	0	0	164	0	0
	Bg 4	344	8	15000	392	0	150	14	182	1	0	343	0	0
	Bg 5	440	15	72000	1106	0	196	13	118	34	16	244	0	17
	Avrg	403	18.6	62920	396.6	0	80.6	5.6	69	11	3.2	163.8	0	3.4
	Total	2015	93	314600	1983	0	403	28	345	55	16	819	0	17
Bruguiera parviflora (Tancang ngaglik)	Bp 1	339	7	256000	337	0	81	0	92	0	0	12	0	0
	Bp 2	360	20	81000	1476	0	84	0	8	0	0	1260	0	0
	Bp 3	392	11	26000	108	3	192	0	188	0	0	640	0	0
	Bp 4	472	9	36000	2828	0	3066	0	1264	0	0	192	0	74
	Bp 5	548	6	72900	3682	0	0	0	552	5	16	206	2	55
	Avrg	422.2	10.6	94380	1686.2	0.6	684.6	0	420.8	1	3.2	462	0.4	25.8
	Total	2111	53	471900	8431	3	3423	0	2104	5	16	2310	2	129
Rhizophora apiculata (Bakau kacang)	Ra 1	916	16	110400	1496	0	469	0	448	0	0	1995	0	0
	Ra 2	846	18	241600	1432	0	1008	0	228	0	0	424	0	0
	Ra 3	581	16	654	2848	0	778	0	1100	0	0	348	0	0
	Ra 4	723	19	99900	1792	0	546	0	728	0	0	680	0	0
	Ra 5	804	25	282500	4288	0	924	0	2872	0	0	1188	0	0
	Avrg	774	18.8	147010.8	2371.2	0	745	0	1075.2	0	0	927	0	0
	Total	3870	94	735054	11856	0	3725	0	5376	0	0	4635	0	0
Rhizophora mucronata (Bakau bandul)	Rm 1	395	51	72000	52	0	25	0	423	19	0	23	0	6
	Rm 2	400	13	57600	91	0	44	0	231	0	0	9	0	0
	Rm 3	389	17	62100	53	0	15	0	259	0	0	14	0	0
	Rm 4	436	22	92700	140	0	67	0	49	3	0	19	0	5
	Rm 5	553	13	21500	259	0	0	0	337	2	0	1815	0	0
	Avrg	434.6	23.2	61180	119	0	30.2	0	259.8	4.8	0	376	0	2.2
	Total	2173	116	305900	595	0	151	0	1299	24	0	1880	0	11
Xylocarpus molucensis (Nyirih)	Xm 1	472	10	29200	0	0	0	0	0	0	0	16	0	0
	Xm 2	304	7	675000	0	0	0	0	0	0	0	0	0	0
	Xm 3	674	21	252500	0	0	0	0	733	0	15	86	0	14
	Xm 4	496	8	25200	0	0	0	0	0	0	0	10	0	0
	Xm 5	394	9	22400	0	0	0	0	0	0	0	5	0	0
	Avrg	468	11	200860	0	0	0	0	146.6	0	3	23.4	0	2.8

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	Total	2340	55	1004300	0	0	0	0	733	0	15	117	0	14
Ceriops tagal (Tancang aneh)	Ct 1	417	7	63000	436	0	416	0	78	0	5	190	0	8
	Ct 2	315	6	36400	195	0	388	0	148	5	5	37	0	7
	Ct 3	331	5	82800	77	0	168	0	210	7	1	66	0	27
	Ct 4	504	5	42800	187	0	504	0	182	0	3	29	0	12
	Ct 5	260	5	59200	408	0	832	0	392	0	15	62	0	15
	Avrg	365.4	5.6	56840	260.6	0	461.6	0	202	2.4	5.8	76.8	0	13.8
	Total	1827	28	284200	1303	0	2308	0	1010	12	29	384	0	69
Aegiceras corniculatum (Gedangan)	Ac 1	356	28	101700	1170	0	714	0	180	0	0	694	0	0
	Ac 2	348	13	42400	70	0	210	0	0	0	0	1681	0	0
	Ac 3	318	11	56700	404	0	588	0	525	0	0	207	1	0
	Ac 4	307	19	74700	1071	0	903	0	330	0	0	3690	0	0
	Ac 5	311	13	176000	168	0	0	0	180	0	0	72	0	0
	Avrg	328	16.8	90300	576.6	0	483	0	243	0	0	1268.8	0.2	0
	Total	1640	84	451500	2883	0	2415	0	1215	0	0	6344	1	0
Soneratia alba (Pidada)	Sa 1	700	63	123200	38	0	0	0	2	0	0	0	0	0
	Sa 2	654	21	1984000	32	0	27	0	18	0	0	2	0	0
	Sa 3	489	33	42800	30	0	2	0	1	0	0	2	0	0
	Sa 4	475	14	158400	8	0	4	0	3	0	0	0	0	0
	Sa 5	475	20	60300	0	0	6	0	7	0	0	5	0	0
	Avrg	558.6	30.2	473740	21.6	0	7.8	0	6.2	0	0	1.8	0	0
	Total	2793	151	2368700	108	0	39	0	31	0	0	9	0	0
Soneratia molucensis (Pidada)	Sm 1	824	14	267500	0	0	37	1	6	0	0	51	0	6
	Sm 2	856	28	262500	30	0	66	0	16	0	0	93	0	1
	Sm 3	610	15	19200	0	0	33	1	17	0	0	91	0	1
	Sm 4	923	67	543600	0	0	56	0	15	0	0	52	0	3
	Sm 5	984	23	440000	54	0	128	0	31	0	0	20	0	0
	Avrg	839.4	29.4	306560	16.8	0	64	0.4	17	0	0	61.4	0	2.2
	Total	4197	147	1532800	84	0	320	2	85	0	0	307	0	11
Avicenia alba (Api-api)	Aa 1	858	46	381600	1295	0	0	0	0	0	0	45600	0	0
	Aa 2	734	33	749700	2978	0	0	0	0	0	0	116800	0	0
	Aa 3	723	66	195000	1820	0	0	0	0	0	0	77600	16	0
	Aa 4	634	69	215000	854	0	0	0	0	0	0	123200	0	22
	Aa 5	768	89	601600	3789	0	0	0	0	0	0	75200	0	29
	Avrg	743.4	60.6	428580	2147.2	0	0	0	0	0	0	87680	3.2	10.2
	Total	3717	303	2142900	10736	0	0	0	0	0	0	438400	16	51
Nypha fruticans (Nipah)	Nf 1	605	53	249900	196	149	84	0	0	0	0	66	40	4
	Nf 2	600	90	212400	27	0	0	0	0	0	0	0	132	7
	Nf 3	593	87	198000	94	98	0	0	0	0	0	0	8	0
	Nf 4	558	160	108000	102	18	0	0	116	0	0	0	0	0

	Nf 5	460	63	54400	79	0	94	0	0	0	0	107	0	0
	Avrg	563.2	90.6	164540	99.6	53	35.6	0	23.2	0	0	34.6	36	2.2
	Total	2816	453	822700	498	265	178	0	116	0	0	173	180	11
Derris heterophyla (Gadelan)	Dh 1	110	0.3	15.2	0	0	4	0	0	0	0	0	0	0
	Dh 2	120	0.47	16.9	0	0	24	0	2	2	1	0	0	0
	Dh 3	140	0.43	13.9	18	0	0	0	1	1	1	9	0	0
	Dh 4	150	0.34	11.8	3	0	0	0	2	0	0	6	0	0
	Dh 5	70	10.42	15.8	3	0	0	0	5	2	1	0	0	0
	Avrg	118	2.392	14.72	4.8	0	5.6	0	2	1	0.6	3	0	0
	Total	590	11.96	73.6	24	0	28	0	10	5	3	15	0	0
Acanthus Illicifolius (Drujon)	Ai 1	155.7	1.19	32.2	0	0	0	0	17	0	0	6	0	0
	Ai 2	192.8	0.91	20.8	0	0	0	0	5	0	0	14	0	0
	Ai 3	172.4	0.68	22	1	0	0	0	24	0	0	0	0	0
	Ai 4	190.3	2.72	0.69	0	0	10	0	10	0	0	18	0	0
	Ai 5	156.4	0.72	21.7	0	0	0	0	5	0	0	22	0	0
	Avrg	173.52	1.244	19.478	0.2	0	2	0	12.2	0	0	12	0	0
	Total	867.6	6.22	97.39	1	0	10	0	61	0	0	60	0	0

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B-03

Effects Of Peaberry Coffee On The Sexual Behavior and The Blood Testosterone Levels Of The Male Mouse (*Mus musculus*)

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Abstract—The purpose of this study was to obtain empirical evidence and reliable informations towards aphrodisiac properties of peaberry coffee. This eksperimental laboratorium research coducted using male mice within 4 treatment groups: group methyl-testosterone as a positive control, negative control, regular coffee powder and peaberry coffee. Oral were given for 7 consecutive days. Blood was taken from the orbital sinus eye and analyzed in a clinical laboratory. The sexual behavior indicator observed were vaginal kissing/days/30 mins. The results showed the average frequencycof vaginal kisssing occurance were 4.66 times in methyl testosterone groups; 2.33 times in negative control groups; 3.33 times in regular coffee groups, and 4.33 times in peabery coffee groups. These data were analyzed using One Way Anova. The result indicating that there were significant differences between the number of kissing vaginal treatment group. Peaberry coffee also affect the increase in average blood testosterone levels in mice, although no significant difference by Anova analysis. The conclusion that can be drawn from this research is the peaberry coffee has a pottential as nutritious boosting aphrodisiac drinks.

Keywords: *Peaberry coffee, Sexual Behavior, Blood Testosterone Levels*

I. INTRODUCTION

Based on data from Indonesian Coffee Festival [1], Indonesia is the third largest coffee producer in the world. Coffee is a beverage that is very popular all over the world. The dringking derived from the processing of ore extraction coffee plant consists of two general types, namely Arabica and Robusta. Until now, coffee has been a popular drink in the world and is consumed by many people. In addition to taste and fragrant aroma, the coffee is also believed to reduce the risk of cancer, diabetes, and other diseases. Familiarize yourself coffee consumption may lower the risk of developing type 2 diabetes [2]. Besides its use for health , coffee in many countries has also become a lifestyle. However, the coffee was Indonsesia various kinds . One is a peaberry coffee.

In Indonesia, especially in the area of East Java, the peaberry coffee used and trusted as the drink is believed to have efficacy as vitality and libido enhancer for adult male. In fact, this statement has become jargon to increase the number of connoisseurs and peaberry coffee sales. But until now, no study has proved that claim. Recent research experts at Coventry University, United States of America presented in the meeting of the annual conference of the Society for Experimental Biology in Salzburg, Austria in 2012 and found that the compound caffeine can trigger muscle strength of older, meaning that caffeine acts as a stimulant to produce more power, Therefore results of these studies may be able to support the efficacy claims peaberry coffee.

The purpose of this study was to obtain empirical evidence and reliable information about public trust and business people about the efficacy aprodisiaka of peaberry coffee at the time after consuming its. The Efficacy may be possible aprodisiak seen from two things, sexual behavior and hormone levels of testosterone. Sexual behavior in mice can be observed from several ways, including, kissing vagina and Mounting [3].

II. METHODS

Type of the research is an experimental laboratory. Research conducted for the provision of peaberry coffee bean powder in male mice and see its effect on testosterone levels and sexual behavior of mice. The object of this research is done on animals male mice (Mus musculus) strain bulb c aged approximately two months with each weighing approximately 25-30 grams. Samples were 45, which consisted of 15 male mice and 30 female mice were divided into four treatment groups. The sample was selected from the population by using simple random sampling techniques. Mice were obtained from the Faculty of Medicine Jember University. The coffee type used in this study is Robusta.

The research design used a completely randomized experimental design to see the effect of coffee bean extract on blood sugar levels and blood testosterone male mice. This eksperimental laboratorium research coducted using male mice within 4 treatment groups: group methyl-testosterone as a positive control, negative control, regular coffee powder and peaberry coffee. The design of this study are described in detail through the steps following studies.

1. Acclimatization mice in cages for 5 days in the laboratory of biology education study program.
2. Divide the sample into four treatment groups: group with a solution of powdered peaberry coffee beans with a dose of 0.10 ml/25 g weight (taken from humans in the habit of consuming coffee in a glass of 250 ml/60 kg weight), a group with a solution of powdered regulary coffee beans with a dose of 0.10 ml/25 g weight, a group with methyl testosterone 42 mg / 100 g weight (positive control), and the group with aquades (negative control), each of which amounted to 5 repetitions.
3. Giving treatment is done every day for 7 days using pipette vulometrik orally.
4. Each male mice in all treatment groups combined with each of the two female mice.
5. Observations sexual behavior of mice done by looking at the behavior of male mice one hour after being given treatment, then observed sexual behavior that is kissing the vagina for 30 minutes for 7 days.
6. Taking blood samples of mice after being treated for 7 days. Blood was sampled as many mice each 2 ml of the sinuses and eye orbital accommodated in ependof.
7. The blood samples were analyzed in a clinical laboratory to determine blood levels of testosterone.

Data collection techniques are a way to measure, calculate, and observed variables including the body weight, the amount of kissing vagina for 30 minutes, the number of mounting for 30 minutes, and testing the levels of testosterone in the blood of male mice using Elisa-test. Inferential statistical analysis carried out as a different test between the treatment groups on levels of testosterone and sexual behavior of mice. The statistical analysis used is one way ANOVA and continued Post - Hoct Tests.

III. RESULTS

After doing research the effects of peaberry coffee powder on sexual behavior and hormone levels of testosterone, with four treatment groups is treated with methyl testosterone (positive control for sexual behavior), the treatment group peaberry coffee, group of regular coffee, and the control group (distilled water), the data obtained as in the following graph :

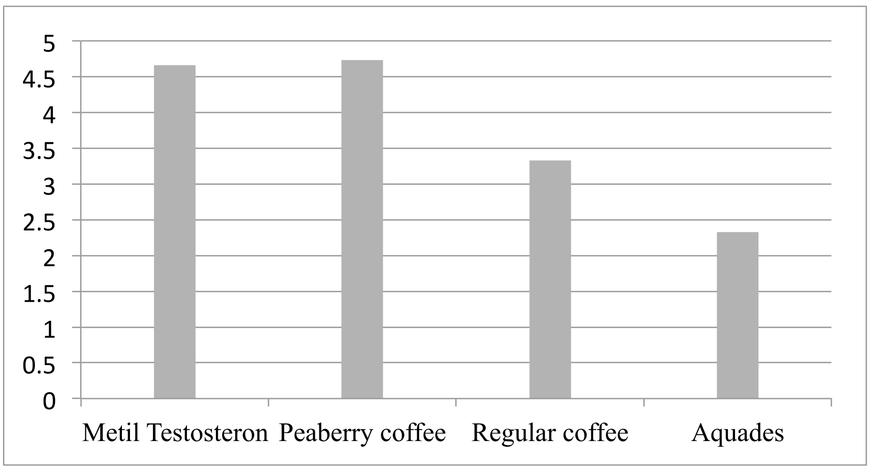

FIGURE 1. Graph Average Number Kissing Vagina / Day/ 30 Minutes Observations

The data shows treatment with methyl testosterone, or a positive control provides high impact to average number kissing agina which is 4.66 times. Methyl testosterone treatment is not much different to the treatment peaberry coffee that is a number of 4.73 times. The graph also shows the effect of treatment of regular coffee and distilled water (aquades) 3.33 and 2.33 times kissing vagina. Data on the number kissing vagina is done analisis of varian test to determine whether the difference in the average number of all treatments were significantly different or not. Table 2 below shows the results of ANOVA test of kissing vagina.

TABLE 2. Results of analisis of varian Test of Kissing Vagina

ANOVA

Kissing Vagina

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	11,960	3	3,987	10,136	,004
Within Groups	3,147	8	,393		
Total	15,107	11			

From table 2 above can be seen that the sexual behavior of mice with indicators kissing vagina when analyzed using ANOVA test showed a value of 0.004. This means that there is a significant difference between the treatment groups to the number of mice kissing vagina. Post – Hoct test required to see any group that has a real difference. Table 3 below shows a summary of the results of the post – hoct test of number kissing vagina.

TABLE 3. Summary of Test Results Post - Hoct Tests

Perlakuan	Nilai Rata-rata
Metil Testosteron	4,66[a]
Kopi Lanang	4,73[a]
Kopi Biasa	3,33[b]
Aquades	2,33[c]

Table 3 above shows that there are no significant differences in effect between peaberry coffee treatment with a positive control treatment, but there are significant differences to the regular coffee and distilled water. The analysis results also showed a significant difference between the treatment of regular coffee by treatment with distilled water or negative control .

In addition to viewing sexual behavior seemed that the vagina kissing indicators, the study also looked at the effects of peaberry coffee on blood testosterone levels. Data from the study of blood levels of testosterone can be seen from Figure 2 following:

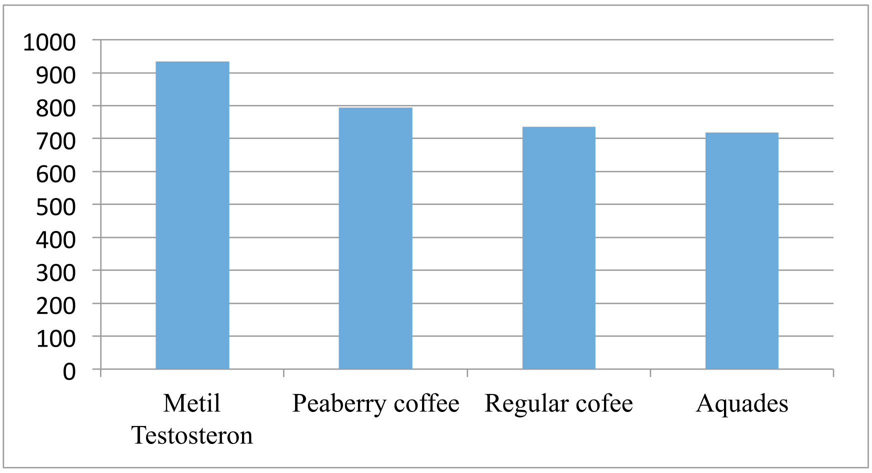

FIGURE 2. Graph of average levels of hormone Testosterone in ng/dl

The above figure shows that there are differences between the effects of methyl testosterone treatment group as a control, treatment peaberry coffee, regular coffee and a treatment group treated with distilled water or negative control. From the graph it can be seen that the group treated with methyl testosterone had average testosterone levels are highest in the amount of 935.2 ng/dl. Followed the average level of treatment group peaberry coffee of 794.2 ng/dl, regular coffee 736.4 ng/dl and distilled water or negative control group amounted to 7.17 ng/dl. To see signifkansi effect of treatment of blood testosterone levels in mice, performed different test using parametric statistical analysis ANOVA one way. Table 4 below shows the results of ANOVA test on testosterone levels in mice.

TABLE 4. Results of ANOVA Test Hormone Testosterone Levels

ANOVA

Kadar Testosteron

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	87254,309	3	29084,770	3,355	,076
Within Groups	69352,660	8	8669,082		
Total	156606,969	11			

The results of the ANOVA analysis showed there was no significant difference in testosterone levels between the treatment groups. From the results of a further test, showed that there were no significant differences in testosterone levels between the treatment peaberry coffee ith regular coffee and distilled water treatments, but significantly to methyl testosterone.

IV. DISCUSSION

The results showed that there were statistically significant differences in sexual behavior between groups of mice treated with both indicators of kissing vagina. However, the data also showed no significant difference types of treatment of testosterone levels in mice, despite differences in effect between treatment groups. It can be caused due to the difference just a little on the hormone levels cause different behavioral responses.

Sexual behavior that showed, in this case the number of kissing vagina can not be separated from the influence of androgens in the male mice. Androgen hormones that play a direct role of sexual behavior is hormone testosterone. The habit of sexual behavior of male depicted in all vertebrate species are dependent on T (testosterone), which is secreted by cells of Leydig in the testes and metabolize the target cells to E2 other (with events aromatication) dihydrotestosterone (DHT, by reduction of 5a) [4], High caffeine content in peaberry coffee or other compounds that interact affect of influence to anabolize or testosterone metabolism. Hormones work more slowly in the body when compared with the nerves, but the hormones work very effectively. Hormones work in very small amounts in the body, but the large-scale effects on the response induced [5]. Thus it makes sense if testosterone levels are not significant, but sexual behavior showed a significant result.

Testosterone levels was not significant between peaberry coffee and regular coffee because the two types of coffee has caffeine content. But the difference between the two is the amount. The caffeine content of coffee varies depending also with the genotypes of different types of coffee, not based on the level of the coffee fruit greenish [6]. This may imply that all types of coffee can actually act as aphrodisiac drink, only in different levels. The Peaberry coffee contains compounds higher caffeine than regular coffee [7]. Caffeine is one of the physiologically active compounds [8]. The compound can act as ligands in tissues which binds to specific receptors to induce a series of chemical processes that gave rise to certain behaviors such as increased levels of the hormone, increased libido, increased sweating, soothing effect and others. One way to increase testosterone levels in the blood that is by giving sandfish (Holothuria scabra) powder [3].

The peaberry coffee significant influence on sexual behavior in mice is also due to the effects of coffee that are vasodilator in blood vessels. Vasodilator effect on blood vessels causing the amount of blood entering the area of the optic nerve and the brain is also more and more, causing the eyes not sleepy. So also in the case of the mice, where we know that mice are nucturnal animals, or animal activity at night, while during the day when they break. By giving the coffee powder orally during the day causes mice to become more active, including in terms of sexual behavior and other activities. “When drinkking coffee or tea, the caffeine is absorbed into the blood stream through the walls of the small intestine. From there, the molecule travels to brain, binding to the receptors that would accept adenosine, a molecule that accumulates when was tired and causes to feel sleepy. So, about 20 minutes after taking it, caffeine helps feel more awake because additional adensoine can't find a binding location” [9].

V. CONCLUSION

The conclusion of this research that there is no significant effect on the treatment of peaberry coffee testosterone levels but significant effect on the sexual behavior of male mice. The conclusion that can be drawn from this research is the peaberry coffee has a pottential as nutritious boosting aphrodisiac drinks.

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B – 04

Primer Designing For Molecular Detection Of *Salmonella* Spp Based On *Par*c Gene

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Abstract— It has been reported the use of QRDR genes that improve taxonomical resolution among member of *Salmonella*. Higher taxonomical resolution was reportedly known by using four genetic markers for QRDR region, namely *gyr*A, *gyr*B, *par*C, and *par*E genes, respectively (Amarantini and Satwika, 2015). In this study, polymerase chain reaction primers, based on parC gene of Indonesian indigenous *Samonella* strains, were designed and used for further spesific detection of *Salmonella* spp. ClustalX, MEGA6, and GeneDoc were used as tools for designing the new primer. Two sets of novel PCR primers, namely parChF and parChR have been developed. The primer pair demonstrated the ability to amplify the targeted gene region. To validate the assay, genomic DNA from *Salmonella* strains isolated from iced tea, cow's milk, and goat's milk were subjected to PCR. The new primer reported here have high resolution, demonstrating its potential for separating *Salmonella* spp.

Keywords: Salmonella *sp, PCR,* par*C, primer designing*

I. INTRODUCTION

Salmonella is known as a big group of bacteria with high diversity among them. Based on its serotypes, it is already realized a number of about 2,500 species. This group is now grouped into 5 species, i.e.: *Salmonella arizonae* (type strain: ATCC 13314); *Salmonella choleraesuis* corrig. (type strain: ATCC 13312), *Salmonella enteritidis* (type strain: ATCC 13076), *Salmonella typhi* (type strain: ATCC 19430) *Salmonella typhimurium* (type strain ATCC 13311) (Skerman *et al*., 1980). Later on it is found a new species, known as *Salmonella subterranea* (Shelobolina *et al*., 2004).

Salmonella enterica subsp. enterica serotipe Typhi (*Salmonella* Typhi) is the only member of *Salmonella* with pathogenic property, causing typhoid fever for man; man is the only host for this bacteria. This fever is known to be infected via fecal-oral through contaminated food and water (Kothari *et al*., 2008).

Molecular detection is possible if one specific marker has been known. As the high molecular diversity is realized among *Salmonella* Typhi strains, it is important to find out molecular marker specific for it based on local isolates. It is then fundamental to isolate indigenous *Salmonella* Typhi from Indonesia. It has been reported the use of gyrB and QRDR genes that improve taxonomical resolution among member of *Salmonella*. The gyrB gene shown to be the best intraspecies genetic marker for strains belonging to *Salmonella* Typhi. It produces higher resolution compared to 16S rRNA, as more clades are produced with more variations (Amarantini and Satwika, 2014). Higher taxonomical resolution was reportedly known by using four genetic markers for QRDR region, namely gyrA, gyrB, parC, and parE genes, respectively, with the order of higher taxonomic resolution based on phylogenetic topological structure and similarity value as follow: parC, gyrB, parE, and gyrA (Amarantini and Satwika, 2015). Polyphasic taxonomic analysis revealed that parC is a potent candidate as molecular marker. It produces the best consistency compared to gyrA, gyrB, and parE genes as shown by its bootstrap value of 99 and 100 (1000 replicate) (Amarantini and Satwika, 2015).

Based on that finding, a research is done to improve molecular identification method by primer designing using conserved nucleotide sequences of parC from indigenous isolates to differentiate members of *Salmonella*. The resulting molecular marker (primer pair) was designed to improve specificity and sensitivity as *Salmonella* marker that could differentiate members of salmonellae with other closely related microbes.

II. MATERIAL AND METHODS

A. Bacterial cultures

Four indigenous isolate of *Salmonella* Typhi obtained from previous studies, denotes as BPE 122.4 CCA R*, BPE 127.1 MC R*, BPE 122.1 CCA^s, dan RSK 5.1 SSA^s were used (Amarantini *et al*., 2009; Amarantini *et al*., 2011; Amarantini *et al*., 2012; Amarantini and Budiarso, 2013; Amarantini and Satwika, 2014). *Salmonella* Typhi NCTC 786 (PT. Biofarma) and *Salmonella* Typhi strain O (BLK Yogyakarta) were used as positive control.

B. Isolation of DNA

DNA was isolated by using standard phenol-chloroform-isoamyl alcohol method (Sambrook *et al*., 1989). Isolation was done according to the protocol written in the manual. Purified DNA was checked electrophoretically as a single band above 12 kb mark on the gel.

C. PCR and sequencing of parC gene

Bacterial DNA, including the control DNA were amplified using standard primer pair (parCF, 5' ATgAgCgATATggCAgAgCg 3' and parCR, 5' TgACCgAgTTCgCTTAACAg 3') (Ling *et al*., 2003) according to the Dream TaqTM Green PCR Mastermix (Fermentas) manual. A gradient thermocycler PeqSTAR 2X was used. The resulting amplicon of 412 bp was realized as a single band on 3% electophoresis gel, visualized by mean of Major Science UV transluminator. PCR products were then purified by using QIAquick gel extraction kit (Qiagen) following the instruction from the manufacteurer, and continued by sequencing which was done by Macrogen, Korea.

D. Primer designing of parC gene

An in silico study was done for designing a new primer pair which was deduced from nucleotide sequences of parC gene of isolates obtained from Indonesia. Targetted gene sequences obtained were analysed by using CustalX2 (Larkin *et al*., 2007), realigned by MEGA5 (Tamura *et al*., 2011) and documented by GeneDoc (www.psc.edu/biomed/genedoc). The resulting conserved sequence was then compared to the database available online by running BLAST. Based on the conserved area obtained, it is used for designing primer pair by using Clone Manager. The newly designed primer was also used for in silico PCR and the resulting amplicon was then compared to the online database for creating a phylogenetic tree.

III. RESULT AND DISCUSSION

In silico study of the newly designed primer was described below. PCR product targetting parC gene of DNA from local *Salmonella* sp strains was sequenced, and then analyzed to checked its similarity. The resulting alignment could be seen in Fig. 1 below, showing the conserved area.

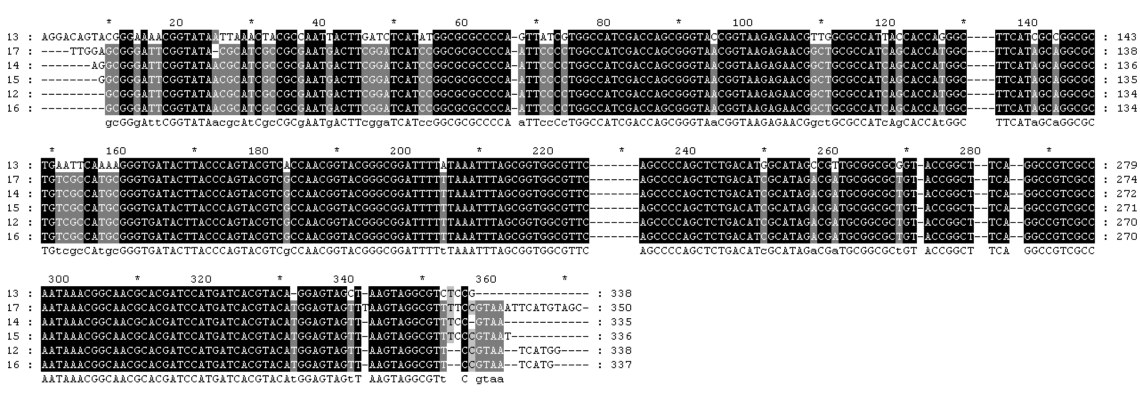

FIGURE 1. Multiple alignment of nucleotide sequences of parC gene of indigenous *Salmonella* sp by using Mega5 and visualized by GeneDoc showing the conserved area (Amarantini and Satwika, 2015).

Based on the conserved area obtained, a new primer pair was designed covering that area. Consideration must be taken in primer designing, especially those which are related to primer specificity and it should not give a mispriming product. The resulting primer pair was named parChF and parChR (sequence data not shown).

For checking the specificity of the new primer pair, the in silico study was done to classify *Salmonella* sp or other organism by comparing to the available online database on GenBank. The resulting phylogenetic tree is shown in Fig. 2 showing that *Salmonella* Typhi is separated into two clades, while *E. coli* which is traditionally known as a closely related species to *Salmonella* sp is recognized as an outgroup. This is reflecting the specificity of the new primer pair to identify and separating *Salmonella* sp strains.

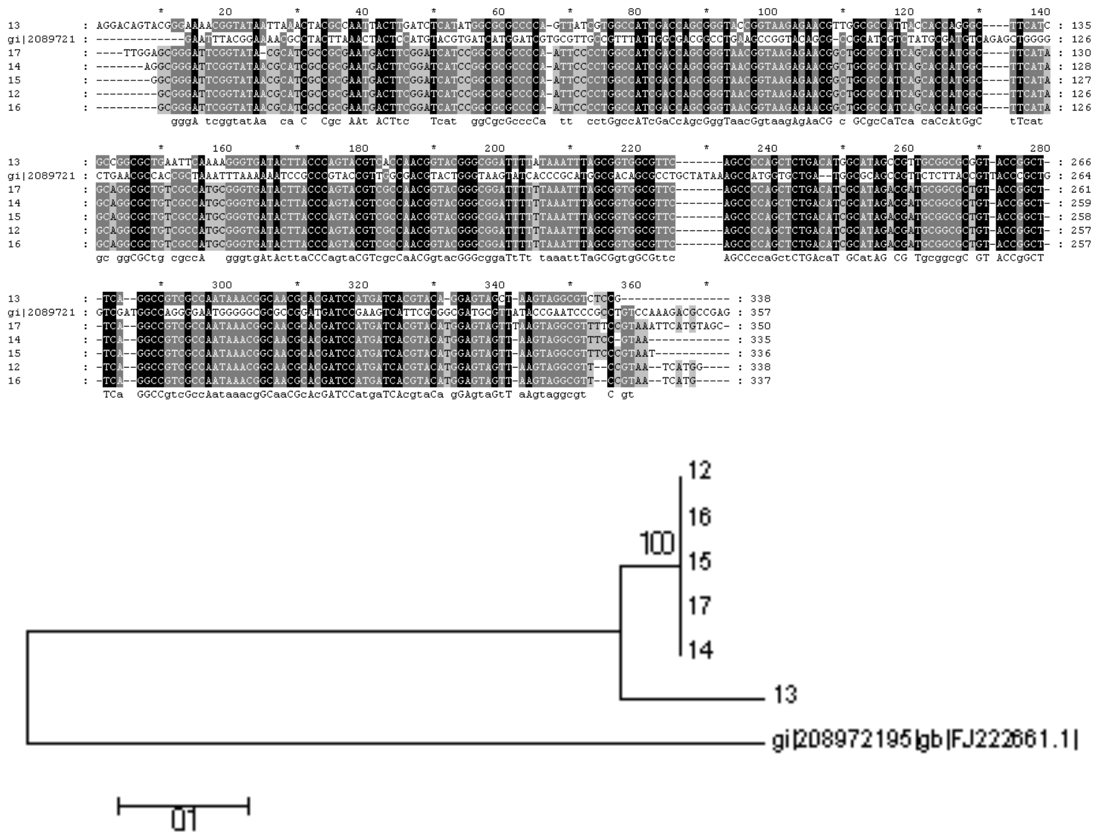

FIGURE 2. Alignment and phylogenetic tree of *Salmonella* sp based on parC gene generated from new primer pair deduced from conserved area of parC gene of indigenous *Salmonella* sp from Indonesia.

As can be seen from the figure above, the newly designed primer produce a taxonomical resolution that could be separated all of the tested strains from *E. coli* ATCC 25922 used as negative control. These results are consistent with the results of in vitro study. In vitro assay of this new primer pair showed the single band of expected length of 315 bp, either for quinolone resistant strain (122.4R), or the sensitive one (122.1 CCAS), as well as for the type strain *Salmonella* Typhi NCTC 786. It could also be seen an amplicon for non-target organism, which is *E. coli* ATCC 25922 used as negative control. However, the PCR product is disappearing when the annealing temperature was set at a higher temperature, i.e. at 60-62^{0}C (Amarantini and Satwika, 2015).

Based on that finding, it could be said that the new primer pair could specifically amplify target gene parC of *Salmonella* sp, and differentiate it with the closely related species like *E. coli*. The newly designed primer pair will be submitted to the GenBank so it could be used for rapid and sensitive detection of *Salmonella* sp based on its QRDR genes.

IV. CONSLUSION

The newly designed primer pair which was deduced based on conserved nucleotide sequence of indigenous *Salmonella* isolates was proven to be specific for members of *Salmonella*. It could be used for rapid and sensitive detection of *Salmonella* spp.

ACKNOWLEDGMENT

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B – 05

Seed's Viability of Two Types of Dates (*Phoenix dactilyfera* L.) from Fruit in Indonesian Market

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***Abstract*—**This research aims to know the seed viability of the two types of Dates on the Indonesian market. This study was conducted in 2014 and 2015, in the laboratory of Mathematics and Natural Science Faculty, Yogyakarta State University. Two types of seeds are selected is derived from Dates fruit, which are large with a lighter color, and the small size with a darker color. Represented by varieties of dates: Sayer (oval-cilindrical, ±3cm, dark orange brown/more light than another) and Lulu (round, ±2cm, dark maroon reddish /more dark than Sayer's).The parameters measured were seed fresh weight, seed dry weight, and seed moisture. Viability test using germination testing (by germination percentage and germination rate); conducted on plastic tray with cotton sheet and fabric covered; fill with 100 grains of seeds. Repeated 4 times. Incubation at room temperature (±30oC).The results were analyzed by compare mean - independent samples t test of SPSS 18'th.The results showed that the viability of both of Date's seeds is high. Sayer's have better viability than Lulu's. This fact indicates that the date palm seed that comes from the fruit market in Indonesia, can be used as seeds material or seedlings.

Keywords: *Dates fruits, Indonesian market, seedling, seed's viabilty,.*

I. INTRODUCTION

Dates are the fruit of which is identical to the month of fasting ; as suggested (' sunnah ') eaten to break the fast . Therefore , many available in the market at the time leading up to and during the month of fasting , and at the time of the return of the haji- as souvenirs. Fruit or plants Palm Dates appears about 21 times in the Holy Koran, and about 300 times in the Hadiths [1]. For Christians there is a ritual ' Palm Sunday '[2].

In the market there are several types of dates are offered; with a variety of shapes, sizes and color of the fruit. Slightly rounded to elongated oval; lengths 3 - 7 cm; with a golden yellow to dark brown - black skin [3].

During this time , the procurement of fruit Dates by imports from countries of the Middle East region ; have not heard of the domestic production. Based on the origin of fruit - Middle East, habitat is the semi-arid region and indicate that the plant palm Dates are adaptive to the type of plants that dry soil conditions and high ambient temperature / extreme.

Our country is a country that allows a wide variety of plants can grow and develop properly . If we can produce date palm, certainly a lot of advantages and benefits that can be obtained. Date palm plant is difficult to grow in Indonesia [4]; but there are people who reported the emergence of seedlings after a month of seeds thrown to the corner of the yard; even in another report says that a palm plant tree can produce fruit.

Generally, after eating palm seeds directly thrown away, or has not been utilized; for example as planting material or seed.

Therefore, it is important to determine the feasibility of a date palm seeds from the fruit obtained from the local market.

II. LITERATURE VIEW

A. Dates Palm

Dates palm (*Phoenix dactylifera* L.) also known ‘Kurma’ (Indonesian) is a perennial plant within the family of Palm, which has been cultivated since 2400 BC [1], as a major food crops , and has a high economic value [5]. Date palms are medium-sized, growing singly or forming a clump with several stems from a single root system. Although treelike in form, they do not grow woody tissue, but are able to support themselves with fibrous, stout, overlapping stems, and may grow to 15–25 m tall (50–80 feet). Leaves are 3–5 m long, with spines on the petiole, and pinnately compound, with about 150 leaflets; leaflets are 30 cm (~12 inches) long and 2 cm wide. They are wind-pollinated and dioecious (male and female flowers on separate plants), but in commercial production, they are often hand-pollinated for better fruit production, and propagated by cuttings, to minimize the number of male (non-fruiting) trees [3].

B. Dates Palm Variety

There are thousands of types of dates [3] there were around 2000s varieties [6]. Various types of fruit Dates are popular in the Indonesian market, among others: Ajwa dates (‘kurma Nabi’), Date crown Dabbas, Date crown Khalas, Date crown Khenaizi, Lulu (Date Crown Lulu), Medjool California, Egypt (Golden Valley), Nagel, Safavid , Sayer (Emirates gold), and Tunisia (Tunisia Date Sunfruit).

Lulu (Date Crown Lulu) from Dubai; looks like Ajwa dates, round, small size and dark color (dark maroon), the texture of soft fruit - not fibrous, sweet. Dates Sayer (Emirates gold) is derived from the Emirates; oval-oblong, medium size, brown-orange older [3], the texture of the fruit a bit soft - fibrous soft, sweet taste (often for material palm juice). There are about 23% of production dates are of this type ; and have high value [3].

C. Dates Palm Germination

Seed germination of dates is ' remote germination ' , where the seedling axis develops at some distance from the actual seed. The first structure to emerge from the seed is called the cotyledonary petiole. It resembles, and many people mistake it for, the first seedling root. The cotyledonary petiole grows downward into the soil (sometimes very deeply) and swells at its base. From this swelling emerges the first seedling root (radicle) and seedling shoot (plumule). The actual cotyledon or seed leaf remains inside the seed, functioning as an absorptive organ called the haustorium. The haustorium transfers nutrients from the endosperm to the young seedling. In palm seeds with remote germination, the radicle persists for some time and produces lateral roots [7].

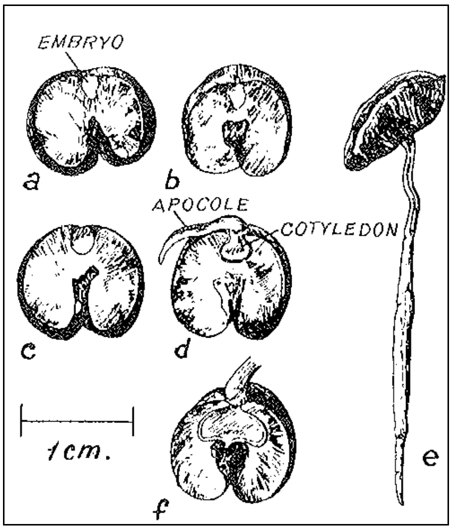

FIGURE 1. CROSS SECTION OF DATES SEED
(SOURCE: S.S. GHOSH, ET AL. 1987: 330)

III. METHOD

A. Tools and Materials

Tools used include: an analytical balance, oven, desiccator, thermometer room, beaker / baker glass 1000ml, measuring cup 50ml and 250ml, funnel glass, tea strainer, glass stirrer, pHmeter, petridish, spray bottles, scissors, length measuring tools , stationery, and image recording devices.

Materials used include: Sayer and Lulu palm fruit, distilled water, labels, filter paper, tissue paper, plastic trays, aluminum foil, plastic wrap, cotton sheets, and cloth napkins.

B. Methode

Viability test carried out using test methods germination. Seed samples tested were from fruit types Sayer & Lulu, which has the physical characteristics (shape, size and color) are different. Germination test using a plastic tray with a media sheet coated cotton cloth (napkin), so it is not easily damaged when penetrated sprouts; filled 100 grain seeds and each repeated four times (according to ISTA & BPSP).

Parameters measured were fresh weight (g), dry weight (g) and grain moisture content (%) at the beginning (new peel from the fruit, and after washing) and at the time after immersion (I and II), and the percentage of germination and speed germination (on the 7th day, 14, 21, and 28). Measurement of dry weight and moisture content of the seeds with the oven method (60 ° C; 3hr). Water content is obtained by the formula 'dry weight basis'.

C. Procedures

The procedure consists of the implementation of the preparation phase (separation and washing seeds), soaking phase (first and second), and a germination test phase.

The preparation phase: separated the seeds from the fruit, washed, then filtered and drained. The first soaking stage: the seeds soaked in bakerglass containing distilled water for a day at room temperature (30-32°C); then washed, and filtered. The second soaking stage: the seeds soaked in bakerglass containing distilled water (4 days; at room temperature); then washed, filtered and drained. Seeds ready to germinate. Phase germination: seeds placed neatly in a plastic tray which was covered with a cotton sheet coated cloth napkins, then shut 'plastic wrap'; incubated at room temperature and kept moist by adding 50 ml of distilled water every day.

FIGURE 2. GERMINATION TRAY

The technique of collecting data through observation and measurement of the seeds, and the seeds are germinated (already appeared apocole / cotiledonary). The data collected was processed and statistically analyzed by t test , using the compare mean - independent sample T -test of SPSS 18 .

FIGURE 3. APOCOLE OF GERMINATION SEED

IV. RESULTS AND DISCUSSION

The average value of Fresh Weight , Weight and Moisture Content Dry Beans Sayer at the beginning before immersion is higher. These data indicate that the size of Sayer seed heavier than Lulu.

TABEL 1. AVERAGE OF FRESH WEIGHT, DRY WEIGHT & WATER CONTENT OF DATES SEEDS

Condition	Dates type	Fresh weight (g)		Dry weight (g)		Water content (%)	
Before washing	Sayer	0.83	*	0.77	*	6.5085	*
	Lulu	0.61		0.58		4.8235	
After washing	Sayer	0.76	*	0.67	*	11.4135	*
	Lulu	0.62		0.56		8.3195	
After soaking I	Sayer	0.77		0.62		20.2615	*
	Lulu	0.76		0.63		17.8530	
After soaking II	Sayer	0.97		0.66		31.3705	
	Lulu	0.93		0.63		32.4955	

NOTE: SIGNIFICANTLY DIFFERENCE AT 95%

The average value of Fresh Weight and Dry Weight of Seed Sayer and Lulu after soaking , both the 1st and 2nd (the last before dikecambahkan) there is no difference. This shows that seed weight at the same time will be tested germination (homogeneous weight).

FIGURE 4. THEDIFFERENCE BETWEEN LULU & SAYER'S

In both types of beans Dates, although the value of Weights Fresh, Weights Dry and Moisture Content at the beginning of the test germination (after soaking second) is the same (at level of 95 %) , but the value of the percentage of germination seeds Dates Sayer has a value higher than Lulu (see Figure 4) .

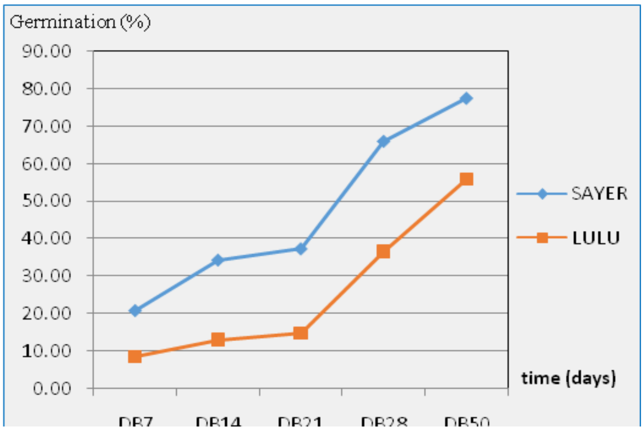

FIGURE 5. GERMINATION (DB) OF LULU & SAYER DATES

This is presumably because seeds Sayer Dates have a larger size so as to have components that are needed to grow a larger [5].

The average value of Water content after soaking the 2nd (the last before germination) no difference; although previous direction (Figure 5) ; it appears that Seed Water Content of Sayer Dates (blue) from the beginning has also been more than Lulu . In fact , then at the end of the second immersion levels are the same , there is a high rate of imbibition at times last.

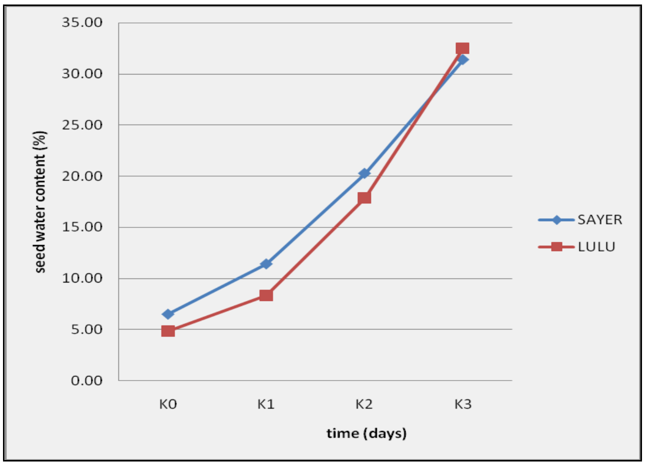

FIGURE 6. SEED WATER CONTEN (K) OF LULU & SAYER DATES
Note: Initial Water Content before washing (K0) & After washing (K1) ; Water content after soaking I (K2) and after soaking II (K3) .

Water absorption quickly, before the membrane had a reorganization could lead to a ' displacement ' component of the membrane [7]. Water absorption occurs slowly can restore normal membrane to form [9].

The high rate of imbibition may adversely affect, among other things because it causes the seeds do not have time to ' get ready ' , and can cause damage due imbibisi to the cell membrane; it is mainly on long beans / aging (though the reason for the latter is not appropriate for Lulu ; as well Sayer and Lulu is a seed 'new') .

Imbibisi make hydration to the previous seed membrane disorganization in the dry state into a reorganization .

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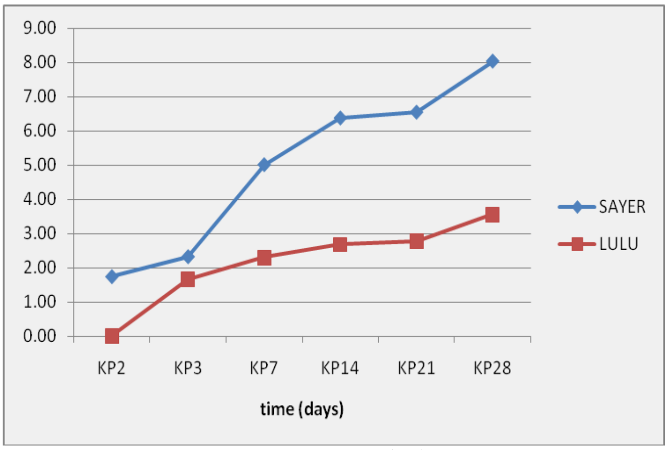

FIGURE 7. GERMINATION RATE (KP) OF LULU & SAYER DATES

The magnitude of the rate of imbibition in the last few days before the germination test this , allegedly also led Lulu beans take longer to begin to germinate than Sayer (see Figure 5).

TABEL 1. AVERAGE OF GERMINATION OF DATES SEEDS

Time (days)	Dates type	germination (%)		Germination rate	
7hr	Sayer	20.7500		5.0208	
	Lulu	8.5000		2.3006	
14hr	Sayer	34.2500	*	6.3851	
	Lulu	13.0000		2.6823	
21hr	Sayer	37.2500	*	6.5547	
	Lulu	14.7500		2.7780	
28hr	Sayer	66.0000	*	8.0456	*
	Lulu	36.5000		3.5621	
50hr	Sayer	77.5000	*		
	Lulu	55.7500			

NOTE: SIGNIFICANTLY DIFFERENCE AT 95%

. Dates seed viability test results in this study can be categorized as high , because it germinated in early germination. In fact , according to some research reports , dates started to germinate between days 26-28 (in Bangladesh) or between the ke14-21 (in Florida) under ideal conditions [10]. In addition, the date stones Sayer and Lulu) has a germination percentage above 50 % within 50 days (see Figure 4) ; given the naturally most families viability palm has a low (less than 20 %) and requires a period of 100 days to germinate [11].

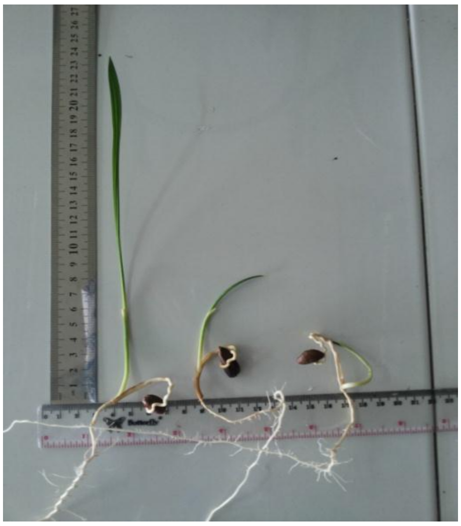

FIGURE 8. DATES SEEDLING

V. CONCLUSIONS & SUGGESTIONS

From these results it can be concluded that :

1. Viability of palm seeds derived from two types of fruit on the market ; Sayer and Lulu , were high .
2. Viability of palm seeds types Sayer higher than Lulu types based on the percentage germination and speed germination.

Suggestions based on the conclusion, Sayer date stones from the fruit can be used as planting material. In addition, the results of this research has the potential to be developed into some further research. Development could add a few things , among others :

1. germination period is extended to 100 days .
2. The parameters of moisture content during the second immersion was measured daily .
3. parameter biomass or seed germination .
4. biochemic aspects , and
5. increase the types of dates , so they can represent 25 % in local market

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B-06

Antimicrobial Activity and Stability of Suji Leaves (*Dracaena angustifolia* (Medik.) Roxb.) Extract

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Abstract— Suji leaves (*Dracaena angustifolia* (Medik.) Roxb.) is one of Indonesian plants that commonly used as food colorant and traditional medicine in recovering gonorrhea, beriberi, and gastritis. Previous research which indicate the content of the active compounds as antioxidants and anti-inflammatory encourage further research on the potential activity and stability as antibacterial. Suji leaves was extracted by solvent with different polarity (ethanol, ethyl acetate, and ethanol:ethyl acetate) in 1, 3, and 5 days of extraction. Its extracts were tested with 10, 20, 30, 40, and 50% of concentration toward Escherichia coli, Bacillus subtilis, and Staphylococcus aureus. The best extraction treatment is defined by stability testing (temperature [80 and 100°C] and pH [4.0, 5.0, 6.0, and 7.0]). Extract at 10% concentration by ethyl acetate as a solvent in 1 day of extraction showed antibacterial activity (MIC = 0.92-1.27%, MBC = 3.69-5.09%) with better stability at pH 4, however unstable against heating temperature and heating time. The selected extract was categorized into low toxic (LC_{50} = 571.98 ppm) which containing hydrocarbons (2-ethylhexyl phthalate [DEHP], 2-Hexadecene, 3,7,11,15-tetramethyl); fatty acid (palmitic acid, linolenic acid, stearic acid); diterpene compounds and their derivatives (neophytadiene, phytol); and vitamins (α-tocopherol).

Keywords: *Antibacterial, Dracaena_angustifolia, pH, stability, temperature*

I. INTRODUCTION

Suji leaves (*Dracaena angustifolia* (Medik.) Roxb.) is one of an Indonesian tropical plant which rich with chlorophyll content that commonly used as a natural green food coloring. Its utilization was also found as a traditional remedy for beriberi, gonorrhea, and gastritis disease [19; 21]. Suji leaves contains several active compunds such as flavonoids, saponins, steroids, and essential fats which contribute as antibacterial agent toward *Mycobacterium tuberculosis* and *Streptococcus pneumoniae* [12], antioxidant agent [17; 28], and anti-inflammatory agent [25]; those enhance potentiality of suji leaves as an Indonesian local leaves.

Functional study of suji leaves as an antibacterial is still limited though its activity of active compounds is already proven on previous studies. In this study, suji leaves was extracted using ethanol, ethyl acetate, and mixture of ethanol: ethyl acetate 1:1. According to [24], a mixture of ethanol and ethyl acetate could work synergistically compared to single solvent in extracting the active compounds; though single solvent extraction get higher yield than mixture solvent. The extraction time was set for 1, 3, and 5 days based on the previous studies; 1, 2, 3 days [18] and 5 days [25]. The extract at concentration of 10, 20, 30, 40, and 50% were tested by well-diffusion method against pathogens food *Escherichia coli* (Gram-negative), *Staphylococcus aureus* (Gram-positive), and *Bacillus subtilis* (spore forming bacteria).

Extract with the best extraction condition and concentration in inhibiting bacteria growth then tested its stability toward heating temperature (80 and 100°C) and heating time (5, 10, and 15 minutes), also toward pH condition (4.0, 5.0, 6.0, and 7.0). Level of heating temperature, heating time, and pH condition were based on the general treatment of the cooking process referred to previous studies [20; 24; 26; 27; 34] which stated that antibacterial compound might still be active in heating treatment within the range 80-100°C and at pH of 8, however pH of 8 was inapplicable for food products. In addition, several analysis were conducted such as proximate, toxicity, compound analysis using GC-MS, also determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC).

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II. Methods

The main material in this study was suji leaves *Dracaena angustifolia* (Medik.) Roxb. Materials for analysis, such as: distilled water, 96% food grade ethanol, 96% food grade ethyl acetate, bacteria culture (*E. coli*, *S. aureus*, and *B. subtilis*), nutrient agar (NA), nutrient broth (NB), HCl 0.1 N, NaOH 0.1 N, H_2SO_4 96%, K_2SO_4, H_2O_2 35%, NaOH 35%, boric acid 4%, mixed indicator, HCl 0.2 N, NaOH 10%, immersion oil, KOH 10%, acetic acid anhydride and shrimp larvae.

This study used experimental methods in three stages: preliminary stage, stage I, and stage II. Preliminary stage covered suji leaves sorting, cleaning, drying (cabinet dryer, 50°C, 24 hours), size reduction (dry blender) and sieving (Tyler, 30 mesh). Proximate analysis was conducted toward suji leaves powder. Stage I (Figure 1) began with the extraction process of suji leaves powder by maceration method (1:10; 20-25°C). Maceration used 3 type of solvents that were ethanol, ethyl acetate, and mixture of ethanol:ethyl acetate (1:1) for 1, 3, 5 days. Filtration and filtrate evaporation were done to get the concentrated extract as antibacterial. Each extract with solvent variation then analyzed to show the antibacterial activity (extraction time [1, 3, 5 days] and extract concentration [10, 20, 30, 40, and 50%]) also counted the yield of extract in determining the most suitable solvent and best extraction time. Antibacterial activity test used well-diffusion method. Yield of extract was determined by percentage of extract weight before and after the extraction process. Stage II (Figure 1) was to test the stability of extract toward heating treatment, both heating temperature (80 and 100°C) and heating time (5, 10, and 15 minutes) also toward pH condition (4.0, 5.0, 6.0, and 7.0); MIC and MBC determination [5]; compound analysis using GC-MS, and toxicity assay [4]. Those assays would be conducted to the selected extract obtained from Stage I.

Statistical analysis on stage I used Complete Random Design of two factors, namely the extraction time (3 levels: 1, 3, 5 days) and the concentration of extract (5 levels: 10, 20, 30, 40, 50%), two replication. Stage II also used Complete Random Design of two factors (heating temperature [2 levels: 80, and 100°C]) and heating time [3 levels: 5, 10, 15 minutes]), two replication; Complete Random Design of one factor was used to determine the effect of pH condition (4 level [4.0, 5.0, 6.0, 7.0]), two replication.

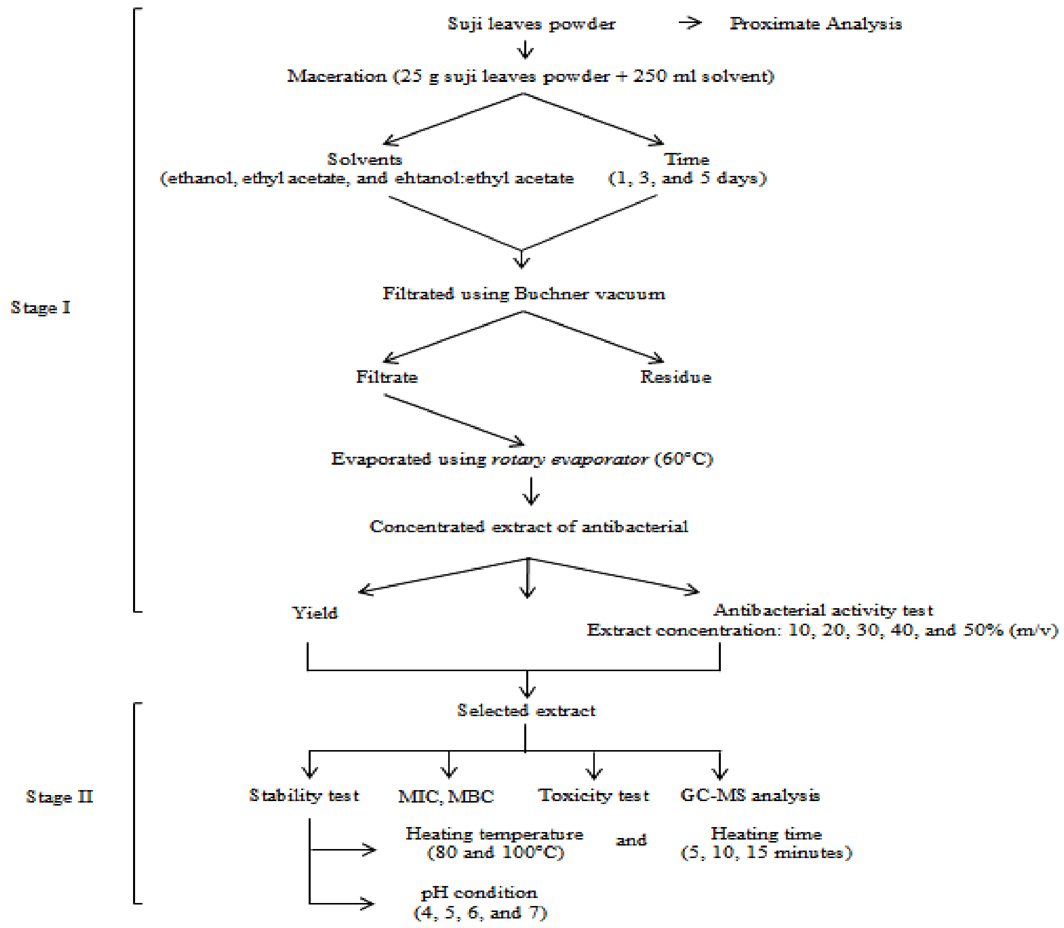

FIGURE 1. Research Flowchart

III. RESULT

A. *Stage I*

Stage I was done to determine the most suitable solvent (ethanol, ethyl acetate, and ethanol: ethyl acetate [1:1]) to extract the antibacterial compounds, the best extraction time (1, 3, 5 days) and the best concentration of extract (10, 20, 30, 40, 50%) that could show the most optimal of antibacterial activity. Proximate analysis was conducted to suji leaves powder resulting 9.51% moisture content, 8.12% ash content, 16.92% protein content, 5.43% fat content, and 60.02% carbohydrate content (by difference).

Table 1 shows an increase of the yield along with an increase of extraction time. Extract by mixture of ethanol and ethyl acetate (1:1) produced higher yield than the extract by only single type of solvent, showing that there were more compounds extracted, could be in active and inactive form [24; 32]. However, a lot compounds extracted was uncertain in showing optimum antibacterial activity, therefore was required a test to show the activity by using well-diffusion method.

TABLE 1. YIELD OF SUJI LEAVES POWDER EXTRACT USING 3 DIFFERENT SOLVENTS

Solvent	Extraction Time (day)	Yield (%)
Ethanol	1	9.95
	3	12.11
	5	11.54
Ethyl Acetate	1	8.63
	3	8.94
	5	10.34
Ethanol-Ethyl Acetate (1:1)	1	10.26
	3	12.07
	5	13.56

The result of antibacterial activity test showed that only extract by ethyl acetate had antibacterial activity while extract by ethanol and mixture of ethanol and ethyl acetate (1:1) showed no antibacterial activity even at a concentration of 50%. The compound is classified as active as antibacterial activity if it could produce inhibition zone by 7 mm [16]. Statistical analysis for all tested bacteria showed an interaction ($p<0.05$) between the extraction time and extract concentration toward antibacterial activity. The longer the extraction time and higher concentration of the extract would increase the inhibition zone (Table 2). The inhibition zone was shown toward all tested bacteria even in the smallest extraction time (1 day) and the smallest concentration (10%). The result to *E. coli*, *B. subtilis*, and *S. aureus* was 10.13 ± 0.16, 9.59 ± 0.68, and 12.62 ± 0.60 mm. Therefore, treatment of solvent extraction by ethyl acetate for 1 day extraction time and concentration at 10% was determined as the selected treatment.

TABLE 2. INHIBITION ZONE SUJI LEAVES POWDER EXTRACT BY ETHYL ACETATE

Extraction Time (day)	Concentration (%)	Inhibition Zone (mm)		
		E. coli	*B. subtilis*	*S. aureus*
1	10	10.13 ± 0.16^{a}	9.59 ± 0.68^{b}	12.62 ± 0.60^{c}
	20	14.67 ± 0.40^{c}	9.51 ± 0.32^{b}	16.33 ± 0.47^{e}
	30	17.49 ± 0.48^{e}	14.08 ± 0.84^{fg}	18.52 ± 0.03^{g}
	40	19.15 ± 0.28^{g}	15.00 ± 0.22^{g}	19.21 ± 0.17^{h}
	50	18.22 ± 0.68^{ef}	18.11 ± 0.95^{i}	20.51 ± 0.05^{i}
3	10	15.04 ± 0.30^{c}	11.35 ± 0.03^{c}	11.06 ± 0.05^{b}
	20	17.03 ± 0.10^{d}	12.68 ± 0.15^{de}	12.86 ± 0.08^{c}
	30	18.79 ± 0.23^{fg}	13.56 ± 0.05^{ef}	16.33 ± 0.20^{e}
	40	22.35 ± 0.49^{i}	17.03 ± 0.03^{h}	17.98 ± 0.15^{g}
	50	24.39 ± 0.19^{j}	19.75 ± 0.17^{j}	19.14 ± 0.21^{h}
5	10	12.54 ± 0.41^{b}	7.54 ± 0.50^{a}	8.92 ± 0.14^{a}
	20	17.37 ± 0.56^{de}	12.00 ± 0.46^{cd}	14.15 ± 0.14^{d}
	30	21.28 ± 0.01^{h}	16.16 ± 0.43^{h}	17.36 ± 0.58^{f}
	40	23.06 ± 0.44^{i}	18.37 ± 0.28^{i}	18.20 ± 0.10^{g}
	50	25.00 ± 0.43^{j}	20.40 ± 0.03^{j}	19.30 ± 0.17^{h}

Note: Different notation showed there was significant difference ($p<0.05$)

B. *Stage II*

Stage II was conducted to determine the stability of the extract toward heating temperature and heating time (80 and 100°C; 5, 10, and 15 minutes) also toward pH condition (4.0, 5.0, 6.0, and 7.0). In addition, the selected extract also tested the MIC/MBC; compound analysis (GC-MS); and toxicity test.

The stability test was conducted toward the selected extract resulting inhibition to *B. subtilis* whereas no inhibition to *E. coli* and *S. aureus*. There was control extract which tested in room temperature condition (~25°C), 0 minute heating, and without any buffer addition (pH 4.09). The statistical analysis showed no interaction between heating temperature and heating time to the inhibition zone ($p>0.05$). Table 3 shows that the selected extract became inactive with the heating temperature (80 and 100°C) and heating time (5, 10, and 15 minutes). The statistical analysis against pH changes showed significant differences in inhibition zone of *B. subtilis* to the changes of pH (4.0, 5.0, 6.0, and 7.0). Inhibition zone was seemed decreasing with the increase of pH condition. At pH 7, the antibacterial activity relatively decline. Optimum growth of bacteria is at pH 6.5-7.5, whereas at low pH conditions (less the same as the pH 4) bacteria cell would need the energy to balance the pH to prevent cell denaturation; causing the cell become weaker and more susceptible to attack by antibacterial compound [2; 11; 37].

TABLE 3. INHIBITION ZONE SUJI LEAVES POWDER EXTRACT BY ETHYL ACETATE

Stability Parameter	Level	Inhibition Zone (mm)		
		E. coli	*B. subtilis*	*S. aureus*
Heating temperature (°C)	~25 (control)	0.00 ± 0.00	9.59 ± 0.68	0.00 ± 0.00
	80	0.00 ± 0.00	1.33 ± 0.48^{a}	0.00 ± 0.00
	100	0.00 ± 0.00	0.87 ± 0.41^{a}	0.00 ± 0.00
Heating time (minute)	0 (control)	0.00 ± 0.00	9.59 ± 0.68	0.00 ± 0.00
	5	0.00 ± 0.00	1.53 ± 0.47^{i}	0.00 ± 0.00
	10	0.00 ± 0.00	1.10 ± 0.25^{hi}	0.00 ± 0.00
	15	0.00 ± 0.00	0.66 ± 0.29^{h}	0.00 ± 0.00
pH	4.09 (control)	10.13 ± 0.16^{n}	9.59 ± 0.68^{r}	12.63 ± 0.60^{z}
	4.0	9.98 ± 0.07^{n}	9.60 ± 0.004^{r}	12.08 ± 0.07^{z}
	5.0	8.74 ± 0.05^{m}	8.24 ± 0.12^{q}	11.09 ± 0.05^{y}
	6.0	7.99 ± 0.02^{l}	7.71 ± 0.04^{q}	10.38 ± 0.14^{y}
	7.0	6.73 ± 0.28^{k}	5.46 ± 0.14^{p}	9.05 ± 0.28^{x}

Note: Different notation showed there was significant difference ($p<0.05$)

MIC is the minimum concentration to inhibit the growth of microbes, while MBC is the minimum concentration to kill 99.90% of microbes. Table 4 shows that MIC/MBC for *E. coli* (Gram negative) was larger than *S. aureus* (Gram positive). Cell of *E. coli* is composed of lipopolysaccharide which is endotoxin agent to make the cell could defense more powerful than *S. aureus* cell [22; 24; 32]. Beside, Gram-positive bacteria such as *B. subtilis* has another capability in defense which is forming spores. Therefore, the MIC/MBC for *B. subtilis* was higher than *S. aureus*.

Toxicity LC_{50} value shows the safety level of extract to be applied to food products. Reference [36] categorizes toxicity into 5 categories: very high toxic (LC_{50}<50 ppm), high toxic (LC_{50} 50-500 ppm), low toxic (LC_{50} 501-1000 ppm), very low toxic (LC_{50} 1001-5000 ppm), and non-toxic (LC_{50}>5000ppm). LC_{50} of suji leaves powder extract was 571.98 ppm (low toxic). The toxicity comes due to the existence of a common antinutrition components contained in various types of plants as a result of metabolism. According to GC-MS analysis toward the extract, was detected di(2-ethylhexyl) phthalate [DEHP] compound (36.95%) that had potency as toxic compound which could cause irritation and diarrhea when ingested 10 g of amount (Agency for Toxic Substances and Disease Registry, 2002). On the application of food products, suji leaves extract surely does not reach the dose and the level of toxicity could be minimized by heating treatment at the time of cooking food. Toxic compounds could be inactivated by heating treatment (Brown, 2011). Therefore, it could be said that the suji leaves extract by ethyl acetate for 1 day at a concentration of extract 10% was safe to be consumed in certain doses.

GC-MS analysis detected major compounds such as: hydrocarbons (2-ethylhexyl phthalate [DEHP], 2-Hexadecene, 3,7,11,15-tetramethyl); fatty acid (palmitic acid, linolenic acid, stearic acid, nonanoic acid); diterpene compounds and their derivatives (neophytadiene, phytol); and vitamins (α-tocopherol). All the detected compounds could act as an antibacterial agent [1; 7; 8; 9; 10; 13; 14; 15; 23; 29; 30; 31; 35].

IV. CONCLUSIONS

Ethyl acetate was selected as the best solvent to extract suji leaves powder. The best extraction was 1 day (at concentration 10%). MIC and MBC values of the selected extract were 1.27% and 5.09% (*E. coli*), 1.71% and 6.87% (*B. subtilis*), 0.92% and 3.69% (*S. aureus*). The extract was unstable against heating treatment, both heating temperature and heating time, also it more stable at pH 4. The selected extract categorized into low toxic (LC_{50} = 571.98 ppm) which contained hydrocarbons (2-ethylhexyl phthalate [DEHP], 2-Hexadecene, 3,7,11,15-tetramethyl); fatty acid (palid, linolenic acid, stearic acid, nonanoic acid); diterpene compounds and their derivatives (neophytadiene, phytol); and vitamins (α-tocopherol).

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B – 07

Anticancer Property of Protein Isolated from Thermophilic Bacteria Against Breast T47D Cancer Cell Lines

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Abstract**—** Many pharmaceutical agents have been discovered by screening natural products from plants, animals, marine organisms and microorganisms. Cationic Antimicrobial Peptides (AMPs) in the protein isolated from bacteria, are an example of an anticancer agent originating from thermophilic bacteria. The aim of this study was to investigate the anticancer activity of proteins isolated from six isolates of thermophilic bacteria (113a, 94b, 153, 104c, 83, 110a). Bacteria was fermented in NB medium with 1% glucose in 55°C for 24 hr. Proteins isolated from cell free extract by salting out method with 60% ammonium sulphate and continued with dyalisis. Anticancer activity was conducted by cytotoxic test using MTT assay. The results of this study showed that proteins isolated from thermophilic bacteria which had anticancer activity toward T47D cell lines were proteins from isolat D153. Proteins from isolat D153 showed the IC_{50} value with 2,35 μg/mL concentration. Proteins from the other isolates (D83, D94b, D110a, D104c, and D113) showed the IC_{50} value with 436,5 μg/mL, 954,99 μg/mL, 629,5 μg/mL, 371,5 μg/mL, 501,1 μg/mL, and D153 2,35 μg/mL consentration respectively for T47D cell lines.
Keywords: *anticancer, protein, thermophilic bacteria , T47D, breast cancer*

I. INTRODUCTION

Cancer is a disease that is characterized by continuous cell division, uncontrolled and can spread to other tissues located nearby. Uncontrolled cell growth is caused by damage to DNA from mutations of genes that control cell division. Mutations can be caused by exposure to carcinogenic agents. This damage begins in the cells then multiply and gain additional changes are favorable for survival between neighboring cells are normal. The abnormal cells multiply to produce cancer-forming cells (MacDonald and Ford, 1997, Lodish et al., 2000, Kokha et al., 2004). Cancer is the result of long-term processes that lead to the effects of genetic drift and molecular changes that the process of change runs gradually. It usually takes a long time to change from normal to increased levels peak, dysplasia, which is phenotypically invasion and metastasis. The accumulation of genetic and molecular changes in a long time provides an opportunity for intervention field clinic for the prevention of cancer initiation and action before premalignant lesions (Crowel, 2005).

In 2002, breast cancer is the most common cancer in women in Indonesia, and in 2005 is the leading cause of death in women in Indonesia. The cause of breast cancer is lifestyle, environmental and genetic factors. The pattern of life include fatty foods, alcohol and little kosumsi fruits and vegetables. Besides a positive family history of breast cancer have a high risk (http://www.who.int/infobase/cancer.aspx). In breast cancer occurs upregulation of ligand-dependent activation of estrogen receptor (ER), which resulted in an anti-estrogen resistance. Some changes in the breast cancer is the abnormal upregulation and regulation of growth factor pathway (EGFR, IGFR, HER2) and signal transduction of intracellular molecules (Ras, Raf, MAPK, Akt). The growth factors such as IGF and EGF can activate ER in a state of availability of estrogen through estrogen receptor phosphorylation mechanism (Rennie et al., 2005). Approximately 80% of breast cancer cases known to have overexpression of Bcl-2. Some apoptotic proteins such as XIAP inhibitors, cIAP1, cIAP2, and survivin is also a breast cancer biomarker (Parton et al., 2001).

A thermophilic organism, is a microorganisms that are able to adapt grows optimally at high temperatures. Termofil microorganisms have been isolated from both terrestrial and marine habitats with high temperatures, for example the area of the volcano and hot springs (Bertoldo and Antranikian, 2002). This grup of bacteria is one of the microorganism that kan produce antimicrobial peptides. Antimicrobial peptides are chemical compounds produced by eukaryotic cells to fight bacteria, protozoa, and viruses function. These compounds can also be found in bacteria, fungi, plants and animals (Hoskin, D. W. and Ramamoorthy, A., 2008).

Differences in biochemical and biophysical properties of the microbe with host cells and their settings which cells become the target of a peptide provides the basis selective toxicity of AMPs. Some AMPs provides a dynamic mechanism in working on a phospholipid bilayer, thereby providing rapid and potent effect (Yeaman, R. and M. Yount, N. Y, 2003).

Some studies had showed that *cationic antimicrobial peptides* (AMPs), had a toxic property toward bacteria but not to normal mammalian cells, and this substances are toxic to cancer cells with cytotoxic activity in wide spectrum. Naturally, AMPs are substances wich produced by eukaryotic cells to kill bacteria, protozoa, fungi and virus. This substances also found in bacteria, fungi, plant and animal. Some studies had showed that synthetic or natural AMPs, could increase the immune system and potential as antibiotic. The electrostatic bond between bacterial component or cancer cells wich have negative charge and AMPs with positive charge was believed had an important role to make a strong and selective bonding to destroy bacterial cell membrane and cancer cells. Peptides have the ability to neutralize lipopolysaccharide (LPS) and increasing adaptive immune reponses (Hoskin, D. W. and Ramamoorthy, A., 2008).

Cancer treatment in general is based on the cancer tissue sampling or by killing the cancer cells and minimize the effect of treatment toward normal cells in the surounding. The current cancer treatment is trough surgery, radiotherapy and chemotherapy, but the third type of treatments have its drawbacks. Operations will be succes in several tumor that has been growing, but it is difficult to treat in the early stages of metastasis (Lodish et al., 2000). Treatment with radiation capable of killing a local tumor, but radiation will also kill the surrounding normal cells. Most chemotherapy drugs such as taxol, 5-fluorouracil (5-FU) and adriamycin have a target on cell division (Boyer and Tannock, 2005), but chemotherapy can cause diarrhea and hair loss. Chemotherapeutic agents are also not effective in cells that mutated p53. So it is necessary to develop new agents for cancer treatment that is safe (Lodish et al., 2000). Chemopreventive is an innovative area in cancer research for developing pharmacology, biology, and nutrition interference, to prevent, repair, and retard carsinogenesis. These actions include preclinical agents and molecular identification, screening in vitro and in vivo, effects of pharmacological and chemical synthesis (Crowel, 2005). Identification and use of effective chemopreventive agent in cancer is an important issue in public health research. To identify potential chemopreventive in cancer some reseach do in vitro test that is relevant for in vivo prevention (Gerhäuser, 2002).

The use of natural materials as a cure for cancer is very desirable, because natural materials have no harmful side effects when compared with chemotherapy that has high toxicity and side effects. Secondary metabolites in biological natural ingredients can be used as traditional medicine against some disease. Chemopreventive agent itself can be defined as compounds that can inhibit and suppress the process of carcinogenesis in humans so that the growth of cancer can be prevented (Kakizoe, 2003). The purpose of this research is to determine the cytotoxic effect of protein on cancer cells T47D

II. RESEARCH METHOD

This study is exploratory and experimental research using thermophilic bacteria isolated from water and sand river Gendol Merapi as research objects.

A. Tools and materials

Thermophilic bacteria, NB Medium, NA Medium, PDA Medium, PD Broth Medium, dimethyl sulfoxide (DMSO), distilled water, methanol, breast cancer cells T47D, fetal bovine serum (FBS) 10%, Fungizone 0 , 5%, 2% Penstrep, Dulbecco's Modified Eagle Medium (DMEM), SDS 10% in 0,01N HCl, Phosphate Buffer Saline (PBS), trypsin, 3- [4,5-dimethylthiazol-2-yl] -2, 5-diphenyl-tetrazolium bromide (MTT), acridine orange / ethidium bromide (100 mcg / ml acridine orange (bio-Rad) in PBS and 100 ug / ml ethidium bromide (bio-Rad) in PBS), ammonium sulphate, LAF, bottle Flash cultures, tubes konikel , pipette, micropipette, blue tip, tissue, erlenmeyer tube, incubator, inverted microscope, hemocytometer, 96 well plate, an analytical balance, ELISA reader, CO2 incubator, cover slips (Nunc), microplate 96 wells,.

B. Inoculum preparation

Inoculum prepared in 100 ml Nutrient Broth medium.. Media prepared in 250ml Erlenmeyer and autoclaved at 121 ° C and a pressure of 15 psi for 15 minutes, thermophilic bacteria grown on agar slant nutrient and incubated at 55 ° C for 24 hours. Reisolation done to create a new culture using a sterile loop and incubation performed again at 55 ° C for 24 hours. One ose isolate transferred to NB medium from NA medium.

C. Batch fermentation

NB medium with 1% glucose in 1.5 liters of distilled water is used as the production medium. Inoculum (10%) trasferred into 200ml NB medium. And incubated again at 55 ° C. After 24 hours, the sample is added to 15 mL tubes, centrifuged for 30 minutes at 3,000 rpm to obtain a supernatant containing no cells.

D. Protein Isolation

Protein precipitation was done by using 60% ammonium sulfate followed by dialysis to remove residual ammonium sulfate.

E. Cytotoxic test to cancer T47D cell lines

The extract is diluted to concentrations of 50%, 25%, 12.5%, 6.25%, 3.125%. Further tested on cancer T47D cell lines. The data obtained is calculated IC50. Cytotoxic test was done by adding the 100µL extract per well. Then incubated at 37 °C for 24 hours. After sufficient incubation, the media was removed and added 100µL new media and 10 mL MTT 5 mg/mL per well. Then incubated 4-6 hours. MTT reaction was stopped by providing a stopper in the form of 10% SDS in 0,01N HCl as 100µL per well and incubated overnight. Results was performed by Elisa reader at a wavelength of 595 nm.

III. RESULT AND DISCUSSION

Large protein concentration was measured using a spectrophotometer at a wavelength of 595 nm. And the results obtained are shown in Table 1.

Table 1. extracellular protein concentration of each isolate

Isolate	Protein concentration	
	µg/µL	µg/mL
D94b	0,8532	853
D153	0,6758	675
D113	0,9446	944
D83	0,6327	632
D110a	0,7779	777
D104c	0,3263	326

These proteins are used to cytotoxic test to cancer T47D cell lines with serial dilutions. Relationship between the concentration of protein and % of living cells is illustrated as follows.

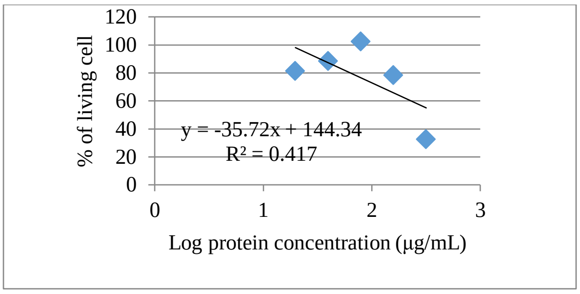

Figure 1. The relationship between the concentration of protein and % of living cells

According to the graph, the IC50 values obtained from isolates D83 is 436.5 µg / mL

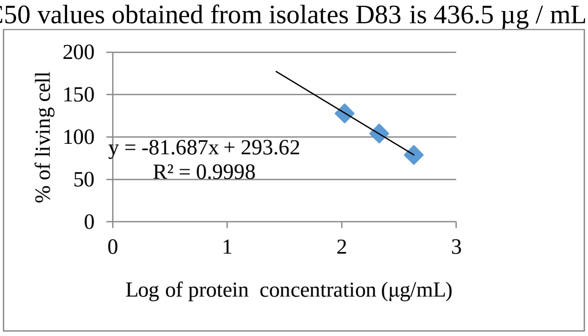

Figure 2. The relationship between the concentration of protein and % of living cells

According to the graph, the IC50 values obtained from isolates D94b which kill 50% of cancer cell lines is 954,99 µg/mL.

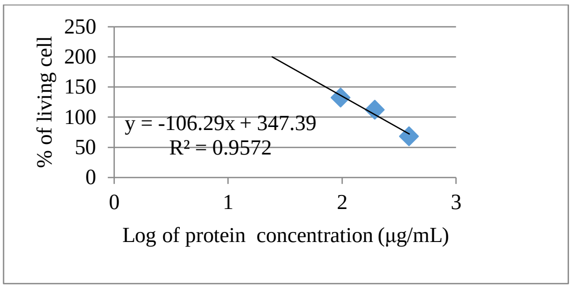

Figure 3. The relationship between the concentration of protein and % of living cells

According to the graph, the IC50 values obtained from isolates D110a protein concentration which can cause death of 50% of cancer cells, is 629.5 µg / mL.

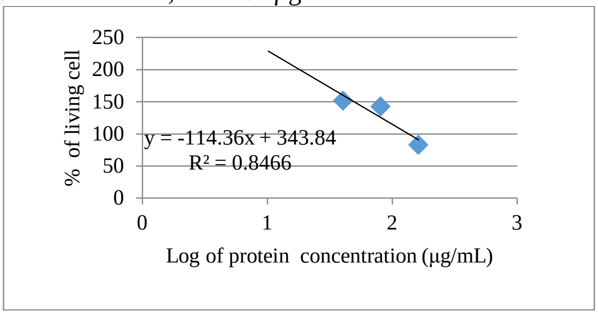

Figure 4. The relationship between the concentration of protein and % of living cells

According to the graph, the IC50 values obtained from isolates D104 protein concentration which can cause death of 50% of cancer cells, is 371.5 µg / mL.

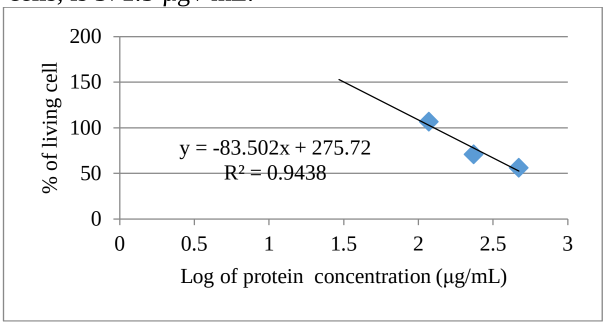

Figure 5. The relationship between the concentration of protein and % of living cells

According to the graph, which shows the IC50 values obtained from isolates D113, protein concentration which can cause death of 50% of cancer cells is 501.1 µg/ mL.

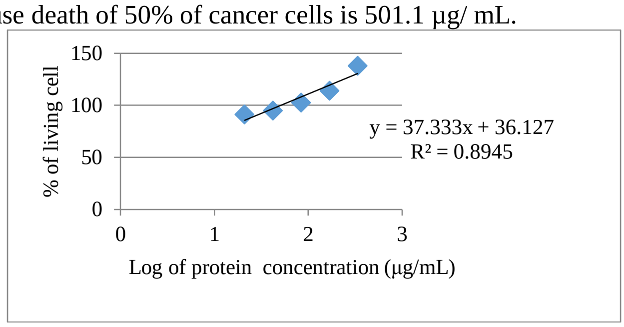

Figure 6. The relationship between the concentration of protein and % of living cells

According to the graph, which shows the IC50 values obtained from isolates D153, protein concentration which can cause death of 50% of cancer cells is 2.35 µg/ mL. Here is a picture of a cell after being treated and MTT.

Several studies have shown that AMP, either synthetic or natural can boost the immune system and potentially as a potential antibiotic. Their electrostatic bonding between cancer cells which are negatively charged and positively charged of AMP can damage cell membranes of cancer cells. Most of

AMP have anticancer and antiviral activity. The peptides were found have the ability to enhance the adaptive immune response (Hoskin, D. W. and Ramamoorthy, A., 2008).

The sequence of amino acids in different AMPs are highly heterogeneous and has a very large variation in the secondary structure. AMPs are generally cationic (have a charge at neutral pH between +2 to +9) and are amphipathic, which allows it to interact with membran peptide and damaging the membrane lipids. Most AMPs have a short structure, consisting only of 5 to 40 amino acid residues, and many of these have length to more than 40 residues. The residue has a positive charge such as Lys and Arg and most have a hydrophobic residue (~ 30% or more) are usually found on these peptides (Hoskin, D. W. and Ramamoorthy, A., 2008).

IV. CONCLUSION AND SUGGESTION

A. Conclusion

Proteins isolated from thermophilic bacteria which had anticancer activity toward T47D cell lines were proteins from isolat D153 (with IC_{50} value 2,35 μg/mL). Proteins from the other isolates (D83, D94b, D110a, D104c, and D113) showed the IC_{50} value with 436,5 μg/mL, 954,99 μg/mL, 629,5 μg/mL, 371,5 μg/mL, 501,1 μg/mL, and D153 2,35 μg/mL consentration respectively for T47D cell lines.

B. Suggestion

Further tests can be carried out on the structure of proteins and the mechanism of action of anti-cancer

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B – 08

ORGANOLEPTIC TEST OF ULTRA HIGH TEMPERATURE (UHT) MILK YOGHURT WITH THE ADDITION OF KATUK LEAVES (*Sauropus Androgynus*)

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Abstract - The purpose of this study is to determine the effect of teh addition of katuk leaves with different concentration to color, aroma, flavor, and texture yogurt produced. The basic material used is milk Ultra High Temperature (UHT) and bacteria *L. bulgaricus, S. thermophillus, L. acidophilus* and *Bifidobacterium* contained in Biokul plain yoghurt with the addition of katuk leaves in 3 concentrations formulas, ie 1 gram, 2 grams and 3 grams. Katuk leaves yoghurt of each formula were made with 3 replications, and then were compared to control (yogurt without katuk leaves addition) organolepticly by five panelists. Data then was statistically analyzed using Kruskal Wallis Test and supported by qualitative analysis. Results indicated that each formula and control showed little differences in terms of color, aroma, flavor and texture, but the differences were not statistically significant. It was therefore concluded that the addition of katuk leaves up to 3 g in 100 ml UHT milk does not affect the characteristis of produced yoghurt and still relatively the same as ordinary yoghurt.

Keyword*: yoghurt, UHT milk, katuk leaves, variation concentration, organoleptic.*

I. INTRODUCTION

One of the katuk's properties that known by public is that katuk leaves can increase the mother's milk for breastfeeding. Simple ways to intensify the mother's milk is to consume katuk leaves as fresh vegetables. Futher development, the extract of katuk leaves are made in the form of pill as medication for increasing the mother's milk (Rukmana dan Harahap, 2003).

Katuk leaves have been processed into various type of food, such as vegetable nodes, vegetable soup, sauteed katuk leaves, katuk porridge, katuk fried rice, omelet katuk leaves, katuk as fresh vegetables and tea with katuk leaves. Various processed forms of katuk leaves have made many people to consume the katuk leaves and get the benefit from it. However, it is not all consumers like katuk in processed form that already exist, so that it is necessary to find another form of processed katuk leaves that is more interesting to attract consumers. One of which is yogurt katuk leaves. Yogurt is a nutrition beverage alternative for consumers who can not consume fresh milk because of lactose intolerance, the inability to degrade the lactose that found in milk because to the lack of lactase in the digestive tract.

According Hasruddin and Pratiwi (2015) yogurt is fermented form of semi solid products produced by fermentation of milk using lactic acid bacteria. Through the chemical changes that occur during the fermentation process created a product that has the specific texture, aroma and flavor. In addition, it contains the nutritional value better than fresh milk. Traditionally, the manufacture of yoghurt starter cultures use a mixture of *Lactobacillus bulgaricus* and *Streptococcus thermophillus* with a ratio of 1: 1. Both bacteria break down the lactose (milk sugar) into lactic acid that yielded various components of aroma and flavor. Therefore, both these bacteria are known as lactic acid bacteria. *Lactobacillus* play bigger role in the formation of aroma, whereas *Streptococcus* perform larger role in the formation of taste (Surajudin, Fauzi dan Purnomo, 2005).

Rukmana (2001) explains that consuming yogurt is very beneficial for nutritional adequacy and improvement of society. Yogurt contains high nutrient with a complete nutrient, as presented in Table 1.

Table 1. Nutritional content in Every 100 g Yoghurt

No	Nutritional content	Amount
1	Calorie	52,00 kal.
2	Protein	3,30 g
3	Fat	2,50 g
4	Carbohydrates	4,00 g
5	Calcium	120,00 mg
6	Phosphorus	90,00 mg
7	Iron	0,10 mg
8	Vitamin A	73,00 SI
9	Vitamin B1	0,05 mg
10	Water	88,00 g

Source: Rukmana 2011

Consuming yogurt can improve the health of the body, because the yogurt bacteria that enters the intestines will envelop the intestinal wall, so that the intestinal wall will be acid. In the acidic conditions microbial pathogens become depressed or unable to attack (Rukmana, 2001).

So far it has not been known the right formula to produce yogurt with the katuk leaves that will make yogurt is still aceptable. It is there fore the purpose of this study is to determine the effect of the addition of katuk leaves to color, aroma, flavor, and texture yogurt produced.

II. RESEARCH METHODS

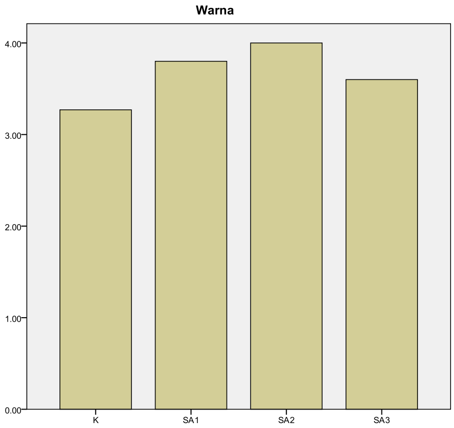
In this research yoghurt was made of Ultra High Temperature (UHT) milk with the addition of katuk leaves in three formulas, namely 1 gram, 2 grams and 3 grams. Lactic acid bacteria culture was obtaind from plain yogurt Biokul. The various concentration of katuk leaves and the use of plain yogurt Biokul were determined based on pre-study. Milk with extract of katuk leaves was fermented for 24 hours at room temperature ($\pm$ 29^{o} C).

Organoleptic tests were carried out after fermentation is stopped by means of pasteurization in accordance with the Indonesian National Standard about Yogurt number 2981: 2009. Five panelists were asked to do an organoleptic test in the senses of color (appearance), aroma (smell), taste (taste), texture (mouthfeel) and then express them in score of 1 to 5. Color test is done by means the panelists observed the katuk leaves yogurt that prepared on the glass and then the panelists gave the assessment in accordance with the scale provided on the questionnaire sheet. Aroma test conducted to introduce the properties of odor of the preparation yogurt produced to the panelists to get the value of the panelists fondness. The test involves the sense of smell, the nose. The test of taste involves the senses of taste, the tongue, and the test of texture is done in a way perceived in the mouth. The obtained data then were described and analyzed using Kruskal Wallis test with significant level of 5%, supported by qualitative analysis.

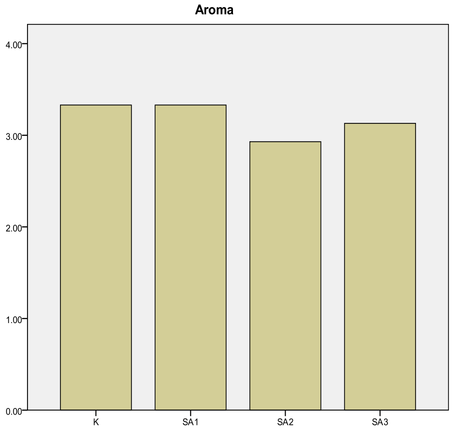
III. RESULT AND DISCUSSION

Results of the research are presented in Figure 1 and Figure 2. The first figure show katuk leaves yogurt after 24 hours fermentation, while the second figure show the results of organoleptic test including color, aroma, taste, and texture.

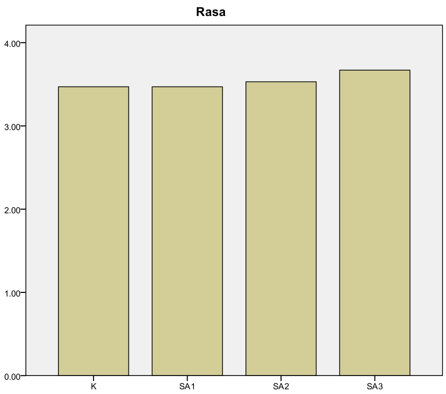
Figure 1. The colors of katuk leaves yogurt



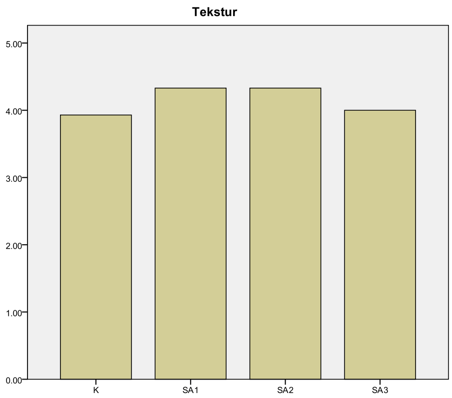
a) colour



b) aroma



c) Taste



d) Texture

Figure 2. Graph of average score by panelists. K= Control, SA1= Formula 1 (katuk leaves of 1 gram), SA2= Formula 2 (katuk leaves of 2 gram), SA3= Formula 3 (katuk leaves of 3 gram)

A. Color

Color is one aspect of the organoleptic test. Direct observations demonstrate that there were differences in color among yogurt control and each katuk leaves yogurt, which can be seen in Figure 1.

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Control yogurt appear white, while the treatments of SA1, SA2 and SA3 were light greens. The treatment of SA3 is greener than the treatment of SA2 and SA1 respectively. It can be said that the higher concentration of katuk leaves is added, the greener color that is produced. This green color of katuk leaves yogurt is caused by chlorophyll contained therein. Katuk leaves contain chlorophyll high enough, old leaf contain 65.8 spa d / mm, and young leaf contain 41.6 d spa / mm (Puspitasari, 2014). This study, however, did not distinguish between the old leaves and young leaves.

In figure 2a), it can be seen that the scores of yogurt color given by panelists are varied. The average color score of the treatment of SA2 (katuk leaves as much as 2 grams) was higher than the treatment of SA1, SA3 and control (no treatment). Control score is the lowest score given by panelists. The average scores of the treatment SA2 is 4 while the average scores given by the panelists for color of SA1 is 3.8 , SA3 is 3.6, and the control is 3.27. It is clear that scores of each formula of katuk leaves yogurt in term of color are different. Even so, result of the Kruskal-Wallis test indicated that all yogurt color had no difference significantly. In other words the panelist fondness on the color of the yoghurt produced is the same.

B. Aroma

Aroma is another aspect of the organoleptic test. Katuk leaves has a distinctive aroma as the smell of the leaves that not everyone likes it. Although the scent can be a quirk of katuk leaves yogurt, but the scent can also reduce the fondness of the panelists. The results of the aroma test can be seen in figure 2.b). In the graph above it can be seen that the average scores given by panelists were similar for the control and treatment of SA1 namely 3.3. The mean scores given by panelists for aroma on the treatment of SA2 and SA3 are 2.93 and 3.13 respectively. These scores showed that the addition of katuk leaves affect panelist fondness on yogurt aroma. They also noted that yogurt aroma of SA2 and SA3 was quite strong. However, result of the Kruskal-Wallis test showed that all the yogurt aroma are not different statistically.

C. Taste

Besides of the color and aroma, taste is also one important factor that affect a person's favorite food products, so that taste is also one important aspect of organoleptic test. Test results of taste can be seen in figure 2.c). The figure above shows that the scores given by the panelists to the taste of all treatment and control are not so much different. The highest average score of yogurt taste is the treatment of SA3, namely 3.67. The lowest average score is the control and treatment of SA1, namely 3.47. Treatment of SA2 has an average score of 3.53. Statistical calculations also show that there is no difference signifiantly between all treatments. In other words, fondness of the panelists to the yogurt taste all treatments are the same.

The taste of yogurt is dominated by sourness as a result of fermentation. Based on the degree of acidity, food can be classified into three groups, namely (1) food with low acidity the pH values is above 4.5; (2) foodstuffs with moderately acidic pH values range from 4.0 to 4.5; and (3) high acidic foods with a pH value below 4.0 (Kuntarso, 2007). Yogurt in this study can be classified low to moderate acidic. The sour taste is caused by the activity of lactic acid bacteria degrade lactose into lactic acid by fermentation. The formation of lactic acid from the fermentation of lactose, resulting in increased acidity of milk or milk pH decreased (Rukmana, 2001). The pH value is one of the characteristics of fermentation products.

D. Texture

The last aspect of the test is texture. Results of the texture test is presented in figure 2.d). The graph above shows that there are differences between the average scores given by the panelists to the texture of the yogurt that produced. Texture on the treatment of SA1 and SA2 had the highest average score than the others, namely 4.33. The average scores for the treatment of SA3 is 4, while the average score of the texture on the controls is 3.93. Statistical test using the Kruskal Wallis test produce significant numbers of 0.490 which is greater than the significant level of 0.05. Therefore, it can be concluded that all treatments are not proven significantly different to the fondness of panelist on the texture of yogurt produced. This is in line with the notes given by the panelists, that all yogurt texture is considered to be condensed resembling yoghurt in the market.

Texture and mouthfeel is one of the important parameters that determine fondness of consumer towards food products (Sinaga, 2007). In this study, the texture test is done in a way perceived in the mouth. All prepared yoghurt were considered to have a thick and creamy texture. This texture is determined by casein that has properties sensitive to acidity (pH). That when the pH is low milk up to ± 4.6, the casein becomes unstable and coagulated (clot) so as to form a solid (Rukmana, R., 2001).

Based on the results described above some notes need to be raised. Katuk leaves yogurt still has a distinctive odor that can decrease the panelist fondness. To that end, need to make katuk leaves yogurt with a distinctive odor that is less pungent. Katuk leaves yogurt that were prepared for the organoleptic test were plain yogurt that may reduce the panelist fondness becouse not all panelists liked the taste of sour. It should be added sweetener before testing to increase the panelist fondness on yogurt. As pH is one of the characteristics of fermentation products, so it is needed to test the pH (degree of acidity) using a pH meter, to find out exactly how sour yogurt produced.

IV. CONCLUSION

Based on the research that has been done, it can be concluded that statistically the addition of katuk leaves up to 3 g in 100 ml UHT milk does not affect the characteristis of produced yoghurt and still relatively the same as ordinary yoghurt. It does not affect the panelist fondness in terms of the color, aroma, taste and texture of yogurt produced.

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B – 09

The Effectiveness of *Aloe vera* Extracts Against Blood Glucose Levels and Repair The Proportion Pancreatic β Cells of The Hyperglycemic Rats

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Abstract — This research aims to determine the effectiveness of *Aloe vera* extracts. L decrease blood glucose levels and pancreatic β cell microscopic structure hyperglycemic rats.This Research used a CRD with five treatments and five replications. Each treatment in this study is consisted of a negative control (given distilled water), B as a positive control (75 mg/kg BW alloxan), C (100 mg/kg of extract of *Aloe vera* and 75 mg/kg alloxan), D (300 mg/kg of extract of *Aloe vera* and 75 mg/kg alloxan) and E (500 mg/kg BW leaf extract of *Aloe vera* and 75 mg/kg alloxan). Data were analyzed using analysis of variance followed by Duncan's multiple range test at 5% confidence interval. The results showed that the extract of *Aloe vera* very significant effect on blood glucose levels hyperglycemic rats. It can be concluded that the extract of *Aloe vera* of 100, 300, 500 mg/kg for 21 days effective in lowering blood glucose levels in hyperglycemic rats and the use of *Aloe vera* at a dose of 500 mg/kg for 21 days and can reduce pancreatic β cell nekrosa proportion to the percentage of 48%.

Keyword : *Hyperglycemic, β Cells, Aloe vera, Rats*

I. INTRODUCTION

High levels of glucose in the blood greatly affect the onset of hyperglycemic in the body. It is influenced by the lifestyle of the people who are less healthy by eating foods that contain high levels of fat and carbohydrates are high that it becomes a health issue most often discussed among people today. According Ganong (1997) blood glucose levels is a very important factor for the smooth working of the body. Blood glucose levels are determined by the balance between the amount of glucose into the blood stream and the amount of glucose out of the bloodstream. The main determinant of the blood glucose level is the amount of food intake, rate of glucose entry into cells, and the activity of liver glucostatic. Hyperglycemic is rising levels of glucose in the blood is indicated by an increase in the percentage of HbA1c.Hiperglikemia cause autooksidation glucose, glycation of proteins and activation of the polyol metabolic pathway which further accelerates the formation of reactive oxygen species (Lasdaukas M, 2008). Molecular modification in various tissues resulting in an imbalance between antioxidants protective (antioxidant defense) and an increase in production is an early bebas.Hal radical oxidative damage known as oxidative stress (Suhartono Eko Setiawan B and E, 2005).

Blood glucose levels increase with the absorption of glucose from food. Increased blood glucose levels occur because of tissue to absorb glucose from the blood and save it in the form of glycogen. When blood glucose levels rise, pancreatic β cells are stimulated to secrete the hormone insulin to lower blood glucose levels (Marks et al., 2000).

The entry of glucose from the intestinal epithelial cells into the blood causes increased blood glucose levels. Normal human blood glucose levels ranging from 80-100 mg / dL (Murray et al., 2003), whereas in mice blood glucose to normal levels ranged between 50-135 mg / dL (Malole and Pramod, 1989).

The use of herbal formulations and various native species that has been attempted for the treatment of diabetes mellitus and has obtained encouraging results from plant extracts in connection with antidiabetic activity, but only partially been explored, among these plants are plants that are easy to get that *Aloe vera*. Research aloe has been carried out by Afaf, *et. al* (2008) administration of ethanol extract of aloe with doses of 100, 300 and 500 mg/kg to male rats diabetic activity, the results showed that blood glucose levels alloxan diabetic rats decreased after administration of ethanol extract of aloe for six days, but Afaf not see the microscopic structure of rat pancreatic β cells hyperglycemic other studies have also been conducted by Bashkar et al (2013) by the same method but this research measure blood glucose levels and see bilirubin heart, and do not measure the microscopic structure of the pancreatic β cells. While research Sema et al (2005) conducted a study using the gel and pulp of aloe, and glibenclamide for 15 days, but from the research results of *aloe vera* (gel and pulp) extract or glibenclamide no significant differences in glucose blood of mice treated with the use of gel and pulp of aloe, and glibenclamide compared with the control group were given PBS and also does not have a beneficial effect on pancreatic β cell microscopic structure of the rat. Therefore, the researchers want to do research on the effectiveness of the use of *Aloe vera* to decrease blood glucose level hyperglycemic rats.

II. METHODS

A. Tool

The tools used in this study is GlukoDr^{TM} Blood Glucose Test Meter (All Medicius, Korea), OHAUS scales with power weigh 2610 g, Erlenmeyer flask with 100 mL size, rat cages of 70 cm x 44 cm x 20 cm, oven, spuid 5 mL, gavage, and stationery.

B. Material

Materials used in this study were 25 rats (Rattus wistar) 3-month-old male with a body weight of 200-250 grams, pellet type 789-S production by PT. Charoen Phokpahan Medan-Indonesia, alloxan, *aloe vera* ethanol, distilled water, and 1% CMC (Sodium Carboxymethyl Cellose).

C. Study Design

This study used a completely randomized design (CRD). Treatment consists of: A = Rat normoglikemik given distilled water as a control, B = Rats were given 75 mg / kg alloxan as hyperglycemic rats), C = hyperglycemic rats were given 100 mg/kg of leaf extract of *Aloe vera* during 21 days, D = hyperglycemic rats were given 100 mg/kg of leaf extract of *Aloe vera* for 21 days and E = hyperglycemic rats were given 100 mg/kg of leaf extract of *Aloe vera* for 21 days. Leaf extract of *Aloe vera* during treatment is done orally (intubation of the esophagus) with doses 0,5ml / 100 g BW.

D. Data Collection Techniques

- Provision Animals Models

  This study used 25 rats (*Rattus wistar*)-month-old male with a mean body weight of 200-250 grams obtained from stables maintance of the Laboratory of Veterinary Clinical Pathology Department of the Faculty of Veterinary University of Syiah Kuala. Rats acclimatized for 7 days in the stable, the experiment, the cage is made of a plastic tub with a size of 70 cm x 44 cm x 20 cm with the top covered with wire mesh and lined hull bottom with a thickness of 3 cm. Experimental animals are given food in the form of pellets, type 789-S, eat and drink provided in *adlibitum*.

- Induction Alloxan In Rat (*Rattus wistar*) Males

  Before the treatment is done, all the rats were weighed for determination of alloxan dose using OHAUS scales with power weigh 2610 g. Giving alloxan be 1 (one) time on the first day of treatment in a dose of 75 mg / kg for 6 (six) days and continued with the use *Aloe vera* with different concentrations. The use of *Aloe vera* is done orally (intubation of the esophagus) for 21 (twenty one) days in treatment C and D. Animal control only given alloxan solvent and water. Provision of treatment carried out at 10:00 am before the animal is fed.

- Making and Giving Extract *Aloe vera* in male rats.

  Leaf extract of *Aloe vera* is obtained by finely grinding the leaves of *aloe* (length approximately 50 cm, thickness 2.5 cm) which had been cleaned and removed the thorns. Then add 70% ethanol was stirred for 30 minutes with a magnetic stirrer and allowed to stand for 48 hours. Results maceration filtered 3 times with buctner funnel lined with filter paper and accommodated erlenmeyer (Voigt, 1994).

The filtrate was evaporated by vacuum filtration results rotary evaporator. Further dilution with 1% CMC (Sodium Carboxymethyl Cellulose) to obtain a dose of 100 mg / BB, 300 mg / BB and 500 mg / BB (Afaf, 2008).

- Examination of Blood Glucose Levels

Examination of the blood glucose levels of mice were fasted for 18 (eighteen) hours prior to the examination of blood glucose levels Santos *et al* refer to. (1978) performed 3 times. The first measurements performed on whole animal before treated and alloxan induced and the use of *Aloe vera*. Initial measurement is intended to ensure that the animal is an animal that is used normoglikemik. The second measurement is done after 6 days induction alloxan treatment, to ensure that the rats treated B, C, D, and E in a positive state of hyperglycemic. Alloxan hyperglycemic rats performed the use of *Aloe vera* every day for 21 days as much as 0.5 mg/100 g BB for each treatment. Glucose measurement is then performed on day twenty-one. Blood samples treated by taking blood on the tail in the rat tail flick and one day after the treatment ended in enthaunasia rats. Blood tests performed using GlukoDr^{TM} Blood Glucose Test Meter. Obtained blood dripped on GlukoDr^{TM} test strips, then after 11 seconds the blood glucose levels indicated on the screen GlukoDr^{TM} Blood Glucose Test Meter and after it is done reading the data. Blood glucose levels were observed to be in units of mg / dL.

- Decision-Making Organs and Histological preparations

Rats make to of *enthaunasia* one day after treatment ended. After surgery carcass, organ pancreas is immediately taken and subsequent histological preparations were made using paraffin. Pancreas specimens were fixed in Bouin solution, then dehydrated using 70% alcohol series to absolute alcohol, clearing in xilol, infiltration and embedding in paraffin blocks 56-58 0C. Preparations are already at *embedding* slashed with a thickness of 4 microns using a rotary microtome. Each repetition in 4 incision made at intervals of 10 incision and placed on glass objects that have been treated with a solution of adhesive. Observation of pancreatic β cells nekrosa in mice stained with Gomori's staining method Chromium Hematoxylin Phloxin which refers to Gridley (1960).

Observations nekrosa pancreatic β cells carried on with a light microscope at a magnification of 10 x 40. Each slice was observed by 3 field of view, so that at each repetition there are 12 field of view observation.

- Data analysis

The data obtained from the study were analyzed using SPSS (version 18) and by analysis of variance. If there is a difference between treatments will continue with the analysis of Least Significant Difference test at 5% confidence interval (Yitnosumarto, 1991).

III. RESULTS AND DISCUSSION

A. *Result*

- Blood Glucose

Levels Analysis of variance on blood glucose levels of rats on a wide variety of treatment showed a treatment effect highly significant (P <0.01). Having followed by Duncan's multiple test, the results can be seen in Table 1.

Table 1 Multiple Range Test on The Mean Blood Glucose Levels

Treatment	Blood Glucose Level Mean mg/dL ($\bar{X}$ ±SD)		
	1st day	6th Day	21st Day
A. Water	80,2 ± 18,34	83,4 ± 14,04^{B}	83,4 ± 16,36^{A}
B. 75 mg/kg BB Alloxan & incubated in 21 days	80,2 ± 22,80	127 ± 27,42^{A}	141,4 ± 51,70^{B}
C. 100 mg/kg BB *Aloe vera*	72,6 ± 38,77	112,8± 26,78^{A}	89,2 ± 7,88^{A}

Extract and 75 mg/kg BB alloxan in 21 days			
D. 300 mg/kg BB *Aloe vera* Extract and 75 mg/kg BB alloxan in 21 days	89,8 ± 19,524	118,8± 13,59^{A}	83,8 ± 10,18^{A}
E. 500 mg/kg BB *Aloe vera* Extract and 75 mg/kg BB alloxan in 21 days	75,2 ± 21,01	126,2± 13,59^{A}	80,6 ± 7,43^{A}

Description: The capital letters A, B superscript in different way shows highly significant difference (P <0.01).

Table 1 shows the mean blood glucose levels in mice treated significantly different with treatment B (P <0.01) and was not significantly different and the treatment C, D, and E (P> 0.01).

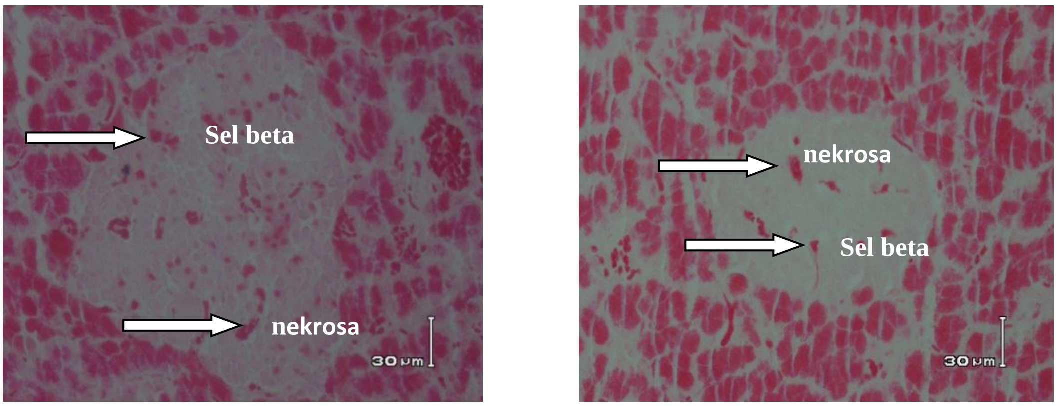
- Nekrosa Pancreatic β Cells

Pancreatic β cells of rats with nekrosa on various treatments can be seen in Figure 1. Analysis of variance of the pancreatic β cell nekrosa treated mice showed a highly significant effect of treatment (P <0.01). After continued with Duncan's multiple range test, the results can be seen in Table 2.

Table 1 The Proportion Mean β Cells Rat Nekrosa In Different Treatment

Treatment	The Proportion Mean β Cells Rat Nekrosa (X ±SD)
A. Water	0,4760 ± 0,0662^{A}
B. 75 mg/kg BB Alloxan & incubated in 21 days	0,8924 ± 0,0359^{D}
C. 100 mg/kg BB *Aloe vera* Extract and 75 mg/kg BB alloxan in 21 days	0,5916 ± 0,0956^{C}
D. 300 mg/kg BB *Aloe vera* Extract and 75 mg/kg BB alloxan in 21 days	0,5432 ± 0,0463^{C}
E. 500 mg/kg BB *Aloe vera* Extract and 75 mg/kg BB alloxan in 21 days	0,4805 ± 0,0696^{B}

Description: the different capital superscript (A, B) shows highly significant differences (P <0.01).



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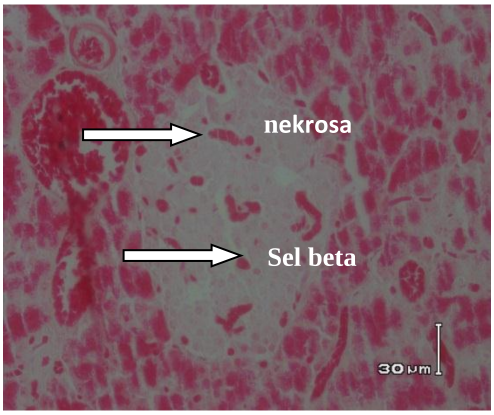

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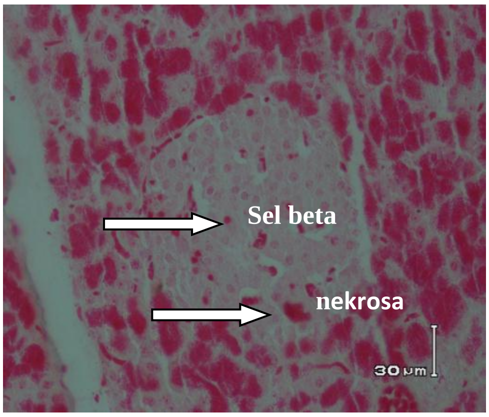

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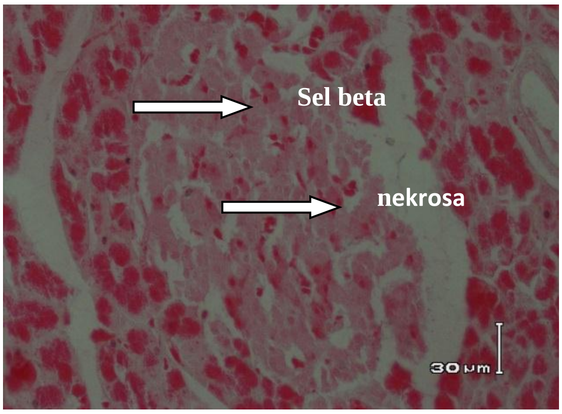

E

Figure 1. Rats' Pancreas Preparations In Various Treatment A (distilled water), B (75 Mg / kg BW alloxan and incubated for 21 Days), C (100 mg / kg *Aloe* Leaf Extract and 75 mg/kg alloxan Over 21 day), D (300 mg / kg *Aloe* Leaf Extract and 75 mg / kg alloxan Over 21 Days), E (500 mg / kg *Aloe* Leaf Extract and 75 mg / kg alloxan Over 21 Days). b is the beta cells of the pancreas, n is nekrosa pancreatic beta cells.

B. Discussion

- Blood Glucose Levels

From the results of statistical analysis showed that the mean blood glucose levels in treatment B (positive control) days prior to the one induced by alloxan 75 mg/kg BW was 80.2 mg/dL, on the sixth day after alloxan induced with 75 mg/kg BW glucose is increased to 127 mg/dL, and on day twenty-one was 141.4 mg/dL. Mean blood glucose levels of rats was higher than treatment A (negative control) on day twenty-one is 83.4 mg / dL. This suggests that elevated levels of glucose in treatment B had experienced hyperglycemia (elevated blood glucose levels) after injection of alloxan, as well as the treatment C, D, and E are also induced by alloxan. This condition is in line with research (Oyedepo, et al, 2013) which states that the increase in blood glucose levels in rats by intraperitoneal injected alloxan may occur >72 hours after alloxan injection, blood glucose levels of rats ≥ 200 mg/dL.

Mean blood glucose levels in rats induced by alloxan treatment C 75 mg/kg BW and accompanied by the administration of 100 mg/kg of *Aloe vera* on day twenty-one is 89.2 mg / dL. Mean blood glucose levels in rats induced by alloxan treatment D 75 mg/kg BW and accompanied by administration of 300 mg/kg BW leaf extract of *Aloe vera* on day twenty-one is 83.8 mg/dL. Treatment E flats rat blood glucose levels induced alloxan 75 mg/kg and with a leaf extract of *Aloe vera* 500 mg/kg is 80.6 mg/dL. This shows a decrease in blood glucose levels significantly with treatment B. Treatment B were significantly different with treatment C, D and E ($P < 0.01$).

This condition is due to the use of *Aloe vera* can lower bl ood glucose levels that act as antidiabetic and antioxidant. According Afaf, *et al* (2008) the effects of antioxidants is to prevent oxidation of glucose and reduce the potential for enzymes that play a role in the transfer of phosphate groups on the glucose which is the initial stage of the glycosylation process. The use of *Aloe vera* can lower blood glucose kadara and increase glycogen in the liver as well as *Aloe vera* may increase the activity of pancreatic β cells in stimulating the biosynthesis and secretion of insulin.

- Nekrosa Pancreatic β Cells

The mean proportion of pancreatic β cell nekrosa in treatment B (negative control) induced alloxan 75 mg / kg BW for 21 days ie 0.8924 significantly different with treatment A is 0.4760 (Table 2). Increased nekrosa in treatment B cells (negative control) (Table 2 and Figure 1) resulted in the production of insulin deficiency resulting in increased blood glucose levels of mice (Table 1), this condition is in line with Guyton and Hall (1997) claim that if the pancreatic β cells damaged the production of insulin deficiency. Insulin deficiency can interfere with the metabolism of glucose is berjumlahnya glucose enter the cells and reduced the use of glucose by the network. This condition causes an increase in blood glucose levels and pancreatic β cells become damaged.

A decrease in blood glucose levels and the proportion of β cell nekrosa rats gradually affect blood glucose levels hyperglycemic mice, and the results of the study also obtained the result of increased doses of *Aloe vera* is given, can reduce the proportion of rat pancreatic β cell nekrosa, it is thought the higher the extract of *Aloe vera* applied, the higher the active ingredient contained in the extract of *Aloe vera* to reduce the proportion of β cell nekrosa treated rats. This is in line with Steencamp and Stewart, (2007), the content of *Aloe vera* can reduce levels of glucose in the blood and can improve the microscopic structure of the β cells of the pancreas is a polysaccharide acemannan and glucomannan, Aloe emodin, glycoproteins, flavonoids, vitamins and minerals.

Glucomannan is a soluble fiber that play a role in improving insulin sensitivity and decrease insulin requirements by helping insulinisasi network more effectively so that there was no increase in blood glucose levels significantly. Just like other water-soluble fibers, *glucomannan* will increase the viscosity of the stomach so that the lower the rate of glucose absorption, causing changes in hormone levels in the gastrointestinal tract such as gastric inhibitory polypeptide (GIP), glucagon, and somatostatin which affects the digestive tract motility, nutrient absorption, and secretion insulin (Bender, 2007). *Acemannan* (B-1,4) -linked acetylated mannan) is the main carbohydrate in Aloe vera (Aloe vera) that most of its content is mannose which can be used as a hypoglycemic therapy (Steencamp and Stewart, 2007). Aloe emodin is an organic compound that activates antrokuinon class levels of insulin signaling as absorbent insulin-beta and substrate-1, phosphatidyl inositol-3 kinase and increases the rate of glycogen synthesis by inhibiting glycogen synthase kinase 3 beta, so it is very useful to reduce the blood sugar ratio, antiseptic and burn treatment (Juprimalino, 2012).

C. Conclusion

The use of *Aloe vera* in mice treated can lower blood glucose levels hyperglycemic rats. And the use of aloe vera *Aloe vera* at a dose of 500 mg/kg for 21 days can reduce pancreatic β cell nekrosa proportion to the percentage of 48%.

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B – 10

The Different Weight of Rice IR64 As Growth Media Toward Pigments Level Generated by *Monascus purpureus*

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Abstract-This study aims to determine (1) the difference in weight of rice IR64 as a growing medium to high levels of red pigment in red yeast rice produced by *Monascus purpureus,* (2) the weight of rice IR64 which is used in the fermentation of red yeast rice in terms of the highest pigment concentration, (3) the quantity of red yeast rice products in terms of pH, and the weight of red yeast rice. This type of research conducted an experimental study. The independent variables in this study is the weight of rice IR64 namely 30 g, 40 g, 50 g and 60 g as a growing medium *Monascus purpureus.* Data were analyzed using One Way Anova and Least Significant Difference Test. The results of this study were (1) based on testing the hypothesis with One Way Anova obtained F count > F table that is 92.824> 1.714 indicates the difference in weight of rice IR64 as a growing medium to high levels of red pigment in red yeast rice produced by *Monascus purpureus,* (2) based on the average of the LSD treatment had significant differences that weight 30 g of rice with the highest levels of the red pigment of 1.9 g / 100 ml, (3) The quantity of red yeast rice products in terms of pH, and the weight of red yeast rice is the optimal pH in produce high levels of the pigment in the weight 30 g of rice is 6.03. Due to the reduced weight after fermentation of red yeast rice 15.23 g and oven 9.00 g.
Keywords: *Rice IR64, Pigments, Monascus purpureus.*

I. INTRODUCTION

Angkak is a product of fermented by *Monascus purpureus* on rice growing medium. Red yeast rice is the product of a relic of the Chinese nation. The benefit of consuming red yeast rice is very good for health because red yeast rice contains lovastatin, known as monakolin K or mevinolin. The quality of the red yeast rice product is very dependent on the level of red pigments are produced. Angkak pigment produced depends on the growing medium Monascus purpureus producing red yeast rice. Kapang Monascus purpureus grow optimally on a substrate containing starch that is commonly found in rice. Rice is used as a growing medium is optimal mold rice containing high amylose and amylopectin low which is rice pera. Rice pera very well be used as a growing medium for amylopectin low so the rice does not stick together which facilitates mold develops during fermentation. Varieties of rice belonging pera rice is rice variety IR36.

The existence of rice varieties IR36 rarely found in the region generally and Singaraja Bali in particular. Rice IR64 be another alternative as a growing medium *Monascus purpureus.* The rice varieties has amylose content is high and amylopectin low so it can be used as a growing medium *Monascus purpureus.* The existence of which is easily available and the high level of consumption of rice IR64 makes very well known by the public. It is highly inversely proportional to the popularity of red yeast rice as a product of fermentation in the community. Under these conditions, the researchers used a weight of rice IR64 as a growing medium to high levels of red pigment in red yeast rice produced by *Monascus* *purpureus* so that it can determine the mass of red yeast rice used in producing household scale. From the preliminary test obtained the highest pigment content ranging from 30 g, 40 g, 50 g and 60 g. The four different weight to be obtained highest pigment content of which is then used as a medium in the fermentation of red yeast rice household scale. Based on the background of the problems that have been described, then the purpose of this study was to determine: 1) Determine the weight differences rice IR64 as a growing medium to high levels of red pigment in red yeast rice produced by *Monascus purpureus* .2) Determine the weight of rice IR64 which is used in the fermentation of red yeast rice in terms of levels of pigment tertinggi.3) Knowing the quantity of red yeast rice products in terms of pH, and the weight of red yeast rice.

II. RESEARCH METHODS

Types of research. This type of research is a real experiment. The study design used was completely randomized design. In a repetition of completely randomized design formula used is t (r-1) ≥ 20.
Population and sample. The population in this study is rice IR64. The sample in this study is the mass of different rice varieties IR64 namely 30 g, 40 g, 50 g and 60 g.
Data analysis technique. The data analysis was tested by ANOVA (analysis of variance) in one direction, dilanjukan the least significant difference test.

III. RESULTS AND DISCUSSION

Result

The data in this study the average levels of the red pigment in red yeast rice is measured by *Optical Density* (OD) are presented in Table 1.

Table 1 Average Measurement of levels of Pigment Red On Red Yeast Rice Based on *Optical Density* (OD)

REPEATED	The average level of the Red PigmentBased *Optical Density* (OD) (g / 100ml)				TOTAL
	I / 30g	II / 40g	III / 50g	IV / 60g	
1	1.98	1.80	1.58	1.37	6.73
2	1.97	1.76	1.55	1.35	6.63
3	1.96	1.74	1.54	1.39	6.63
4	1.93	1.74	1.51	1.25	6.43
5	1.82	1.69	1.47	1.21	6.19
6	1.81	1.63	1.44	1.23	6.11
Sub-Total	11.47	10.36	9.09	7.8	38.72
Average	1.91	1.73	1.52	1.30	6.45

According to the table 1 we can see that the average of the levels of red pigment in red yeast rice is measured by Optical Density respectively is 1.91 g / 100 ml, 1.73 g / 100 ml, 1.52 g / 100 ml , 1.30 g / 100 ml.

In the measurement of the red pigment in red yeast rice is based on *Optical Density* (OD) gained an average of the highest levels of pigment in the mass of rice 30 g ie 1.91 g / 100 ml. The average pigment produced the lowest levels on the mass of rice 60 g of 1.30 g / 100 ml. The big difference in the levels of red pigment in the red yeast rice because rice mass difference. The lower the mass of rice, the higher levels of the red pigment in red yeast rice rice while the higher mass of red yeast rice, the lower levels of the red pigment. This can be seen in the diagram the average levels of the red pigment in red yeast rice presented in Figure 1

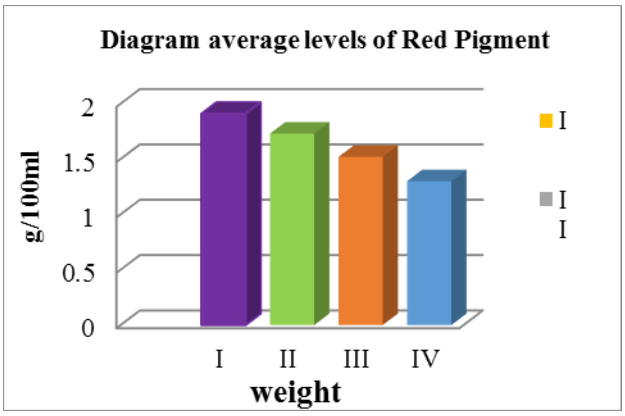

Fig. 1 Diagram average Measurement levels of Red Pigment On Red Yeast Rice Based on Optical Density

Presentation of Data Supporting

Supporting data in this study is the result of fermentation of red yeast rice pH measurement and the measurement of the weight of the media after fermentation and after the oven. Here is presented each measurement.

a) Measurements *Angkak* pH

Measurement of pH during fermentation of red yeast rice which is 14 days carried out to determine the average pH generated during fermentation. In this study, the pH measurement is done by using litmus paper performed twice i.e in day 7 and day 14 . Data show that the difference in pH at day 7 and 14 the pH decreases. Here is the result of the measurement of pH in the fermentation of red yeast rice are presented in Table 2.

Table 2 Results of measurement *Angkak* pH

Repeat	*Angkak* pH							
	Day 7				Day 14			
	30 g	40 g	50 g	60 g	30 g	40 g	50 g	60 g
1	6.7	6.8	6.8	6.9	6.0	6.3	6.5	6.7
2	6.6	6.8	6.9	7.0	6.1	6.4	6.5	6.7
3	6.7	6.7	6.8	6.9	6.1	6.3	6.6	6.7
4	6.6	6.8	6.9	7.0	6.0	6.3	6.5	6.6
5	6.6	6.7	6.9	7.0	6.0	6.4	6.6	6.7
6	6.6	6.8	6.9	7.0	6.0	6.3	6.6	6.7
Average	6.63	6.76	6.86	6,96	6.03	6,33	6.55	6.68

b) Thickness Measurement *Angkak*

Angkak weight measurement performed twice ie after fermentation, after oven / drying. The purpose of media weight measurement is performed to determine the difference in weight of the resulting media before fermentation, after fermentation and after the oven. The tools used in measuring the weight of the media is analytical balance. The data show that there is a difference weights *angkak* after fermentation and after the oven. Here is the result of weight measurement angkak presented in Table 3.

Table 3 Thickness Measurement Results *Angkak*

repeat	*Angkak* weights							
	after the Fermentation				after oven			
	30 g	40 g	50 g	60 g	30 g	40 g	50 g	60 g
1	15.71	23.25	34,29	44.31	8.98	18.35	28.51	38,00
2	14.06	24.73	35.71	43.92	9.36	18.55	28.92	38.11
3	15.32	25.41	36.42	44.11	9.25	19.72	29.70	38.56
4	14,00	24.27	35.31	43.33	9.50	18,32	28.61	37.19
5	16.11	23.19	35.21	45.71	8.60	18.88	28.76	38.29
6	16,21	24,50	36.31	44.31	8.34	19.02	29.13	37.11
Average	15.23	24.23	35.54	44.28	9.00	18.80	28.93	37.87

Discussion

Differences Rice Varieties IR64 As Media Grows toward Red Pigment Levels In *Angkak* Produced by *Monascus purpureus*

Based One Way ANOVA test results showed that the significance value ≤ 0.05 ≤ 0.05 and the 0,000 F count> F table that is 92.824> 1.714. Under the provisions of testing the hypothesis that $H_{0 \text{ is}}$ rejected and H_1 accepted, so there is a weight difference of rice IR64 as a growing medium to high levels of red pigment in red yeast rice produced by *Monascus purpureus.* On the results of observations obtained an average grade red pigment in red yeast rice as measured by *Optical Density* (OD) at each mass of 30 g, 40 g, 50 g and 60 g respectively of 1.91 g / 100 ml, 1 , 73 g / 100 ml, 1.52 g / 100 ml, 1.30 g / 100 ml.

Based on the content of the pigment obtained above can be seen that the higher the weight of rice IR64, the lower the levels of the red pigment is produced. Value conditions can be influenced by several factors namely the bioreactor, the surface area of growing medium, the pore size growing medium, inoculum / starter, and oxygen. These factors greatly affect the speed of oxygen diffusion and adsorption of the pigment to the substrate. Bioreactors is the venue for the process of decomposition by fungi growing medium, in this study bioreactor used is a petri dish. The surface area and pore media, namely rice grown in the bioreactor IR64 affects how quickly the oxygen diffusion and adsorption of the pigment to the substrate. More or less inoculum in a growth medium or substrate will affect the growth of mold in producing the red pigment (Dikshit & Tallapragada 2011) . Pigment produced in this study have differences when compared to the research conducted by Agus Purwanto (2011). The study was conducted by comparing the three varieties of rice that are used in the fermentation of red yeast rice which Cisadane, IR64 and IR36. In this study, the weight of rice IR36 used equalized, so that the levels of red pigment obtained is very different on rice variety IR64 which is equal to 0.24. Acquisition of pigment levels also differ if *Monascus purpureus* grown on media instead of white rice. In Kasim *et.al* 2006 study compared the levels of pigment resulting in growing medium brown rice cultivars sump Butong and BP 1804 IF. Results obtained brown rice cultivars obtained Butong sump red pigment concentration of 0.37

and brown rice cultivars BP 1804 IF 9 obtained pigment concentration of 0.42. The big difference in the content of amylose and amylopectin to amylose content in white and red rice can affect different levels of the red pigment.

Heavy Rice Varieties IR64 Used In *Angkak* Fermentation Seen From Pigments Highest Levels

Based on test results obtained LSD significance level of $0.00 \leq 0.05$ so that the average treatment have significant differences. Weight rice 30 g has a value of *Mean Difference*> 0.05. Results indicating that the rice weight produce the highest levels of the red pigment is 30 g.

Weight rice IR64 30 g produce the highest levels of pigment, so it can be used in the fermentation of red yeast rice. High levels of pigment produced is influenced by several factors namely the bioreactor, the surface area of growing medium, the pore size growing medium, oxygen and inoculum. These factors greatly affect the speed of oxygen diffusion and adsorption of the pigment to the substrate. Weight rice IR64 30 g in petri dishes bioreactor has a high surface area and pore media grows larger than the mass of other rice. High surface area and pore larger media led to the space between the substrate in the bioreactor, so that the oxygen concentration at the lower substrate and the diffusion of oxygen from the air heading into the substrate. Optimal diffusion of oxygen to the substrate is very important that no ethanol is produced during fermentation (Dikshit & Tallapragada, 2011).

Optimal diffusion of oxygen greatly affect the growth of inoculum to produce pigment. If the optimal growth of the *Monascus purpureus* pigments produced will be optimal. The red pigment is produced at the end of the exponential phase of growth and an increasing number in the stationary phase. At the end of the log phase of the average production of red pigment showed a slowdown (Turner, 1971). High mold growth to produce the pigment of red yeast rice between the day 6 and day 14. After that time has stopped the growth of mold on the substrate and pigment production was decreased (Teng *et.al*, 2001). Pigment production occurred on the 6 day which on this day happened intracellular and extracellular pigment production. Increased levels of red pigment occurs after the 6th day. Production of pigment on the 6 day towards the end of the exponential phase and early stationary phase to late stationary phase that is the phase in which the nutrient substrate has been diminishing and secondary metabolites begin to form pigment. Pigment formation will increase at day 14. This is because the source of nutrients that can be used for the growth of *Monascus purpureus* is still available on the substrate until day 14, and the mold is still using carbon and nitrogen sources on the substrate so that the molds are still using the products resulting from growth in the first phase to produce secondary metabolites, especially pigments (Damayanti *et.al.,* 2009).

The resulting pigment subsequently undergo a process of adsorption on the substrate. Adsorption of pigment on the substrate starting from the pigment intracellular diffusion out of the cell membrane to the *Monascus purpureus.* Hyphae are the pigments will penetrate the substrate ensuing pigment adsorption to the substrate. Adsorption pigment is affected by the surface area and pore size of the substrate. The wider the surface of the rice IR64 more pigment is absorbed, so that the adsorption process can be more effective. The larger the pore size of rice IR64, the higher the pigment molecules that enter the substrate (Timothy, 2004).Statement is in line with research conducted by Dikshit and Tallapragada (2011) which examined the levels of pigment on different substrates ie *Oryza* spp, *Colocasia* spp, *Manihot* spp, and *Fagopyrum* spp. The results showed that the highest levels of the pigment produced by *Oryza spp* and lowest levels of the pigment produced by *Colocasia* spp. From these results the rice had the highest pigment content because it contains high amylose and amylopectin low. Differences in surface area and pore substrate can also affect the level of pigment produced. The surface area and pore on rice substat better than the other so that the adsorption of the pigment to the substrate becomes more optimal.Pigmen produced during the fermentation of red yeast rice will decline if the fermentation time is more than 14 days. Decreased levels of pigment associated with the amount of nutrients used by *Monascus purpureus* in the formation of pigment that has been used up. Decrease the amount of nutrients causing decomposition and the structural changes that will lead to discoloration of the pigment. Pigment discoloration caused damage to the chromophore group that changes bonds or functional groups the dye due to oxidation and fermentation time is too long (Irdawati, 2010).

Product Quantity *Angkak* Seen From pH, and Weight

In the observational study measured *Angkak* quantity of products in terms of pH, and the weight of red yeast rice. In the measurement of pH observations performed twice i.e in the day 7 and 14. On day 7 and 14 gained an average pH of 6.63 and 6.03. At a pH of 6.63 was formed in the early phase stationary or pigment formation and at a pH of 6.03 is formed on the stationary phase. Near-neutral pH levels at the beginning of the fermentation because it produces compounds of organic acids such as pyruvic acid, lactic acid, acetic acid as a primary metabolite. These acids resulting from the breakdown of the carbon chains of glucose and the subsequent release of hydrogen atoms that produce organic acids. During the fermentation pH decrease as a result of acidic compounds in the media used by mold in growth (Juzlova *et.al.,*1996). The formation of pigments to be more stable at pH 6, culture will grow quickly and spread on the surface of the media. On the other hand pH can indicate the stability of the pigment of red yeast rice alcohol solvent. Does not seem to degradation due to the interaction of water in ethanol, slightly so that the pH does not affect the stability of the pigment. This interaction may be the termination of the ester bond in rubropunctamin or monascorubramin. *Angkak* pigment is not properly used in aqueous acidic foods such as fermented milk. Instead Angkak pigment suitable for use in dry food or alcohol-based beverages.

During the fermentation process occurs weight media. Media weight reduction caused by their use of the media during the process of metabolism. The longer the fermentation there will be a progressive increase in the level of consumption of nutrient mold on the media. The metabolism of the fungus carried out enzymatically with the aid of exoamilase and endoamilase and through glycolysis. In the metabolism of *Monascus purpureus* on starch media came first enzymatic process which can be used to solve complex substrate becomes simpler. In this case the starch is broken down into simpler substrates i.e glucose.. Other enzymes found in red yeast rice is maltase, invertase, lipase, alpha-glucosidase, oxidase, and ribonuclease (Purwanto, 2011). Enzymes above very important role in metabolic processes including the α-amylase enzyme which is endoamilase. This enzyme hydrolyzes α-1,4 glucosidic on amylose and amylopectin randomly to generate desktrin and maltose. Furthermore, the product will be hydrolyzed by the enzyme other glucogenic into glucose. A-amylase enzyme or called *exoamilase* hydrolyze the polysaccharide chain through chain termination at the cores of maltose from the non-reducing ends of the chain. Then proceed with the steps in the glycolysis when nitrogen in the media runs out then will be transferred into the secondary metabolites such as pigments (Gandjar *et.al.,* 2006).

During oven decline in this case because the media weight loss of water content at 70 ^{0} C were carried out for 24-48 hours. Disappearance of water content in red yeast rice is done to remove the mineral elements that are still contained during fermentation in order to obtain maximum levels of pigment. *Angkak* pigment stability on heating up to 100 ^{0} C. If the heating temperature over 150 ^{0} C for 1 hour will be decreased levels of pigment, it happens because the pigment decomposes and changes in the group structure of the chromophore of the pigment, causing discoloration due to the kinetic energy of the hot (Kasim *et.al.,* 2006).

IV. Conclusions and suggestions

Conclusions

1. Based on the hypothesis test Anova One Way obtained F count> F table that is 92.824> 1.714 indicates the difference in weight of rice IR64 as a growing medium to high levels of red pigment in red yeast rice produced by *Monascus purpureus*
2. Based on the LSD test with a significance level of 0.000 <0.05, so that the average treatment had significant differences that weight 30 g of rice with the highest levels of the red pigment of 1.9 g / 100 ml.
3. The quantity of red yeast rice products in terms of pH, and the weight of red yeast rice is the optimal pH in produce high levels of the pigment is 6.03 pH criteria 6. Lower the weights after fermentation of red yeast rice and rice oven on all the different weight.

Suggestion

1. Further research needs to be done with the addition of other ingredients in a medium to grow *Monascus purpureus* so as to accelerate the fermentation time.
2. Further research needs to be done to take advantage of local rice varieties locally as a growing medium *Monascus purpureus.*

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B – 11

Diversity and Adaptability of Fiddler Crabs at Different Habitat in Pulau Bai, Bengkulu

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***Abstract*—**Fiddler crabs (*Uca spp*.) have abundant of species number currently identified. They live as detritivore at intertidal zone and distribute widely in tropical and subtropical areas in the world. We conducted study of fiddler crabs in Bengkulu, one of province in Indonesian located in Sumatra Island. Most of its area abut on Indian ocean. This study aimed to find species diversity, population density and adaptability of fiddler crabs in Pulau Bai of Bengkulu. The study was carried on for three months started from January to March 2015. Sampling locations were decided purposively on the three stations considered to variety of ecosystem distinction in Pulau Bai, Bengkulu where fiddler crabs were observed. The stations were mangrove vegetation area, fish pond and abut on fisherman community area. Samples of fiddler crabs were collected through digging and catching method from 1x1 m of sixty quadrants in three stations. The results found six species of fiddler crabs i.e. *U. perplexa, U. lactea, U. jocelynae, U. triangularis, U. rosea, and U. coarcata*. Over all stations, population density of fiddler crabs in Pulau Baii ordered from higher to lower were *U. perplexa* (19.19/m²), *U. jocelynae* (6.86/m²), *U. rosea* (1.30/m²), *U. triangularis* (0.93/m²), *U. lactea* (0.26/m²) and *U. coarcata* (0.20/m²), respectively. Of six fiddler crabs species, only two species i.e. *U. perplexa* and *U. jocelynae* were found at three distinct habitats at Pulau Bai. However, *U. perplexa* was a fiddler crab which possess higher adaptability to live at different habitats. They live at all three habitats at Pulau Bai and possess highest both in population number and density. Even, its population were raised at the habitat which abut on fisherman community area that relatively dirty due to many organic wastes.

Keywords: *adaptability, Bengkulu, diversity, fiddler crab, Uca.*

I. INTRODUCTION

Fiddler crabs belong to Ocypodidae family of Crustacea, currently more than one hundred species were identified worldwide [1,5,8]. Many species of fiddler crabs are endemic across tropical and subtropical areas such as *Uca formosensis, U. tangeri and Uca cumulanta* [2-4]. The name of fiddler crab refers to male's feeding behavior. It feed by moving small claw across another very quckly and repeatedly for supplying food to its mouth so that resembles motion as a musician moving a hand across a fiddle [8,9].

Adult fiddler crabs show distinct morphology between male and female. A character vigorously different is claw size. The claws shape of fiddler crabs has been used for species identification as one of alternative tools in crab's genus Uca classification [9]. Female has two claws with the same size, whereas male has one claw that extremely bigger (major claw) than another (minor claw) [5]. Major claw function as weapon in battle for depending its area [1]. Male also used major claw in waving signal as well as constructing sand burrow to attract female in part of mating behaviors [6].

Across subtropical and tropical areas, intertidal zone of coarse beach was more like location that fiddler crabs live. Fiddler crab life as detrivore that feeds on dead organic material, especially plant and small animal detritus. It created burrows as shelter that spread at sandy and muddy area of beach especially covered by mangrove vegetation. Feeding activity of fiddler crabs increase air circulation in the sediment of its habitat [11]. Those facts show that fiddler crabs contribute in ecological role in shore ecosystem. Burrows have cetral role of fiddler crab life, deliver a number of function that support them to exist in intertidal areas that always changes rapidly anytime. Burrow morphology are difference among species of fiddler crabs and affected by substrate type and vegetation that grow at its habitat [6].

Mangrove forest are a source of organic matter for primary producers, in which fiddler crab usualy found abundantly [7]. Bengkulu, one of province in Indonesian located in Sumatra Island. Most of its area abut on Indian ocean. One of its area is Pulau Bai in which almost sorounded by Indian ocean. Pulau Bai possess mangrove forest, but in recent year, deforestation for palm oin plantation and daily life activity of fisherman around could damage the mangrove ecosystem. This study aimed to find species diversity, population density and adaptability of fiddler crabs at different habitats in Pulau Baii of Bengkulu

II. MATERIALS AND METHOD

A. Experiment Site

Experiment was decided purposively at three stations possess different habitat in Pulau Baai, eastern part of Bengkulu district. Station one was located in mangrove habitat of mangrove forest. Station two was located at habitat directly abutted to sea water. There was not vegetation grow at this sampling station. Station three was located at the area that met and intervened by daily life fisherman activity. They used intertidal zone of this location for fish drying under sunlight. At this area some fish were fallen onto sandy land surface where fiddler crabs live.

B. Sample Collection

Fiddler crabs were collected at 9.00 AM to 3.00 PM every four week for three months started from January to March 2015 at three stations during low tide condition. Sampling method was excavated quadrat [Johnson, 2003]. Fifteen quadrats of 1 m^2 were randomly placed at each stations. Quadrat was surrounded by 0.5 m in high of multiplex wood to ease catching crabs. Fiddler crabs on the surface of quadrat were directly catch. Whereas fiddler crabs inside burrow were catch by digging the burrow up to 30 cm in deep. Collected samples were counted, photographed, recorded of sex type, thereafter released again except some of them were transported to laboratory for species identification and preservation procedure.

Species identification was conducted based on [9] and [8]. Recorded sample collection were used for counting of population density and analyzing of habitat adaptability. Population density was decided base on Brower, and Zar [12] as follow : $D = Ni/A$, whereas D for density; Ni for total collected samples; A for square area in m^2. Preservation of collected samples was condunted base on wet preservation procedure using ethanol 70%.

III. RESULT AND DISCUSSION

A. Fiddler Species at Pulau Bai, Bengkulu

We recorder 433 fiddler crabs from three stations of observation at Pulau Baii, Bengkulu. All of these samples were identified belong to six spcies of fiddler crabs i.e. *Uca perplexa* (Milne-Edwars, 1837), *Uca jocelynae* (Shih Hsi-Te, 2010), *Uca triangularis* (A.Milne-Edwars, 1873), *Uca rosea* (Tweedie, 1937), *Uca coarcata* (Milne-Edwars H, 1852), and *Uca lactea* (de Haan,1835). Front and back side of those species can be seen on figure 1.

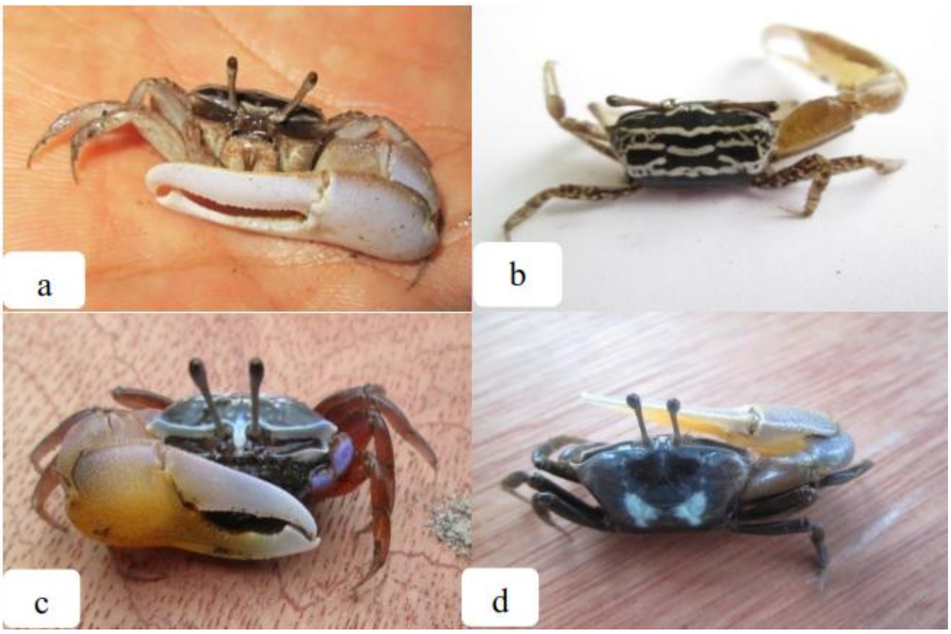

FIGURE 1. Frontal and carapac view of *U. perplexa (a,b); U. jocelynae (c,d); U. triangularis (e,f); . U. rosea (g,h); U. coarcata (I,j)* and *U. lactea (k,l).*

Uca perplexa along with *U. jocelynae* were found at all stations. *Uca perplexa* was recorded in higher number compared to remaining five species. *U. jocelynae* at Pulau Bai possess three different color variation of its carapace, but carapace pattern was same. These difference could be caused by internal factor as genetic factor or external factor as ecological condition at those three stations. *Uca triangularis* was only found at station 1. It made burrow among mangrove root. This species differed easily to othes species due to intense white carapace with grey spots and grey striped pleopods. *Uca rosea* also only found at station 1, possess black color carapace with small number of white spots at anterior body. Pleopods has same color with carapace and claw was bright red. *Uca coarcata* also anly found at station 1. It lives at watered mud substrate. *Uca lactea* was fond at station 1, possesses white color carapace and white claw.

B. Population Density of Fiddler Crabs

Of 433 fiddler crabs that were found, we recorded that among stations have different species, population density as well as total density of fiddler crabs. Table 1 shows number of fiddler crabs at each sampling station, species availability and total number of fiddler crabs for all stations. *U. perplexa and U. jocelynae* have higher population density compared to remaining species (Table 2)

Table 1. Species and number of recorded sample of fiddler crabs at Pulau Bai

Species	**Stasiun 1**	**Number of crabs**	**Stasiun 2**	**Number of crabs**	**Stasiun 3**	**Number of crabs**	**Total**
Uca perplexa	√	68	√	58	√	163	289
Uca jocelynae	√	58	√	33	√	12	103
Uca triangularis	√	14	−	−	−	−	14
Uca rosea	√	20	−	−	−	−	20
Uca coarcata	√	3	−	−	−	−	3
Uca lactea	√	4	−	−	−	−	4
Total		167		91		175	433

Table 2. Population density of fiddler crabs at Pulau Bai

Species	**Stasiun 1 (ind/m²)**	**Stasiun 2 (ind/m²)**	**Stasiun 3 (ind/m²)**	**Total (ind/m²)**
Uca (celuca) perplexa	4.53	3.86	10.80	19.19
Uca (Gelasimus) jocelynae	3.86	2.20	0.80	6.86
Uca (Celuca) triangularis	0.93	0	0	0.93
Uca (Deltuca) rosea	1.3	0	0	1.30
Uca (Tubuca) coarcata	0.20	0	0	0.20
Uca (Celuca) lactea	0.26	0	0	0.26
Total	**11.08**	**6.06**	**11.6**	28.74

Population density of *U. perplexa* was highest omong six species that were recorded at Pulau Bai. There awere 289 individuals with population density of 19.19 ind/m² over all station. *U. jocelynae* share its location with *U. perplexa* were 103 individuals with population density of 6.86 ind/m². Both species almost dominated every location at three stations. *U. triangularis, U .rosea, U. coarcata* and *U. lactea* were only found at station 1 with low population density. *U. coarcata* has lowest population density among six species with 0.2 ind/m². It supposed that *U. coarcata* has very selective substrate type for its life. As stated in [4] that some species of fiddler crabs only like specific type of substrate for life.

C. Adaptability of Fiddle Crabs

Table 1 shows availability of each fiddler crab species at every station. At station 1 all six species were recorded. Whereas, at both station 2 and 3 only two species i.e. *Uca perplexa* and *Uca jocelynae* were recorded although population density between two species was different at every habitat. *Uca perplexa* possesses highest adaptability among six species of fiddler crabs at Pulau Bai as reflected by its highest population density and availability at three different habitats.

Uca perplexa was found at all stations in higher number compared to remaining five species. As well as *Uca jocelynae* was also located at three different stations. Each station has diferent habitat. Station 1 located at mangrove forest. Station 2 located at intertidal zone which has not vegetation. Station 3 located at the intertidal zone met with fisherman shelter and activity. These fiddler crabs species show high capability for adaptation and high tolerated to different habitat although at the area in which activity of people was there [12]. Even though *Uca jocelynae* population was not as much as *Uca perplexa*, both specie capable to share its habitat and adaptation in different habitat condition. They live at all three habitats at Pulau Bai and possess highest both in population number and density. Even, its population were raised at the habitat which abut on fisherman community area that relatively dirty due to many organic wastes. Some species of fiddler crabs can live together at the same habitat, but they possess different behavior. [2,9].

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B – 11

Non Parametric Analysis to Tackle Species Richness

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Abstract—This paper is the literature study based on the original topic *Estimating the Richness of a Population When the Maximum Number of Classes Is Fixed: A Nonparametric Solution to an Archaeological Problem* by Metin I. Eren, Anne Chao, Wen-Han Hwang, Robert K. Colwell. Class richness from samples remains is not only a challenging, but also would be an essential goal. The statistical tools have been developed for estimating species, but just assuming only a lower bound of species or classes. In fact, there are numerous situations, particularly in the cultural realm, where the maximum number of classes is fixed. In order to overcome this reason needs a new method to estimate richness when both upper and lower bounds are known.

Keywords: *richness, rarefaction, extrapolation, upper and lower bounds*

I. INTRODUCTION

The richness is defined as the number of species in a biological assemblage, it would be the simplest and the most intuitive concept for characterizing assemblage diversity ([1];[2];[3];[4]). The measurement of richness is not always straightforward ([5]), but must face the problem of how well a sample reflects a community's ''true'' (asymptotic) richness ([6];[7]). So, extrapolating from the known to the unknown is now an essential objective in ecology, paleontology, and conservation biology ([8]), and a variety of statistical tools for estimating species or class richness have been developed, as such rarefaction ([9];[10];[11];[12], parametric estimators ([13]), and nonparametric estimators ([14]).

Upper limits for the number of species is determined in ecological and biogeographic assessments of richness, that can be found in a particular region are rarely, if ever, known, because species can immigrate, emigrate, speciate, become extinct, hide, get lost, or simply be too rare to be observed with practical levels of sampling effort; also new species are constantly being discovered ([15]), primates ([16]). In fact, there are always more species lurking somewhere in a study region, even vagrants from elsewhere. As such, biological richness estimators have been universally constructed without a known upper bound as a constraint. The other side, most richness estimators have a lower bound set, sensibly enough, by the observed number of species or classes, it has been commonplace for archaeologists to apply these singly-bounded richness estimators to samples of stone artifacts in order to estimate the ''true'' artifact richness of an assemblage ([17];[18];[19];[20];[21];[22];[23],[24];[25]). Archaeologists often treat stone tools like biological entities, so that new classes can always be discovered ([26];[27];[28];[29]). Fieldwork and excavation in new geographic areas and/or time periods may yield unique, novel forms. Moreover, with an increased understanding of stone tool production techniques is called flintknapping and tool uses, new ''technological'' and ''functional'' classes that previously went unnoticed can be discovered and described by reexamining previously studied artifact assemblages [30];[31];[32]). Typology being a number of criticisms have been persuasively leveled against the standard practice of stone tool classification, including its subjective, non-quantitative nature ([33]) and the unavoidable inter-observer variability that it yields ([34];[35]). The purpose here is to contrast them with an objective, logical alternative: paradigmatic classification. Paradigmatic classification is defined by Dunnell ([36]) as a dimensional classification procedure in which the classes are defined by intersection, with each dimension being a set of mutually exclusive alternative features. Figure 1 provides a visual representation of paradigmatic classification ([37];[38]). The fixed of intersection of dimensions of features, the maximum of classes possible for the assemblage under examination is fixed produces significantly a paradigmatic classification (Figure 1 and caption), given the classification. In other words, the upper bound of richness is fixed and known a priori. In terms of estimating assemblage richness from

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a sample, this constraint is a fundamentally different one from what ecologists or biologists usually face because biological and ecological taxa are usually ‘‘extensionally’’ defined.

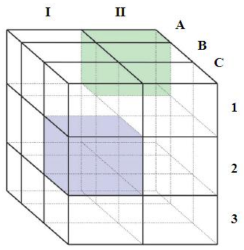

Figure 1. A three-dimensional representation of a paradigmatic classification of three dimensions. For example, any item possessing the attributes ‘‘I’’, ‘‘C’’, and ‘‘20 would fall into the blue square class, while any item possessing the attributes ‘‘II’’, A’’, and ‘‘10 would fall into the green square class. Redrawn and modified from (Figure 4 in [36]: 72).

Enumerating selected attributes shared by the unit’s members derives an extensional unit; the criteria comprising the unit are based on observed attributes of the actual members already placed in the unit. As Dunnell notes, extensionally defined units are restricted in their utility to defining what is already known. Alternatively, ‘‘intensionally’’ defined units, such as those created by paradigmatic classification, ‘‘specify a set of features which objects, whether known or unknown, must display in order to be considered referents for a given term’’. The necessary and sufficient conditions for membership in a unit are comprised by an intensional definition; it explicitly lists the distinctive attributes that a phenomenon must display to be identified as a member of the unit.

A. An Example of Incompatibility

In a non-parametric estimator, Chao1, was used to estimate richness of paradigmatic classes of stone tools from seven late Pleistocene archaeological sites in the Lower Great Lakes region of North America. Here, ‘‘nonparametric’’ means that we do not need to specify a class abundance distribution. Thus a non-parametric estimator can be applied to all types of class distributions. The Chao1 estimator, developed for ecological applications, is based on the concept that rare species carry the most information about the number of species present in the assemblage, but not observed in a sample from it. Thus Chao1 uses only the singletons and doubletons to estimate the number of unobserved species. Importantly, a 95% confidence interval can be calculated for this richness estimator ([40]).

The stone tools under analysis are known as ‘‘unifacial stone tools,’’ a family of tools used by Clovis Paleoindians in Late Pleistocene North America (≈11,570 – 10,800 BP, [41:254]) for a variety of scraping, cutting, and engraving tasks (for examples, see Figures S1, S2, S3, S4, S5). Criteria for two paradigmatic classifications were devised to classify, first, the overall shape of a stone tool and, second, the shape of its constituent parts. An analogous situation would be the creation of two classification schemes for, first, the shape of Swiss Army knives and, second, the gadgets contained within each one. The ‘‘tool shape’’ paradigmatic classification consisted of three dimensions with three, six, and six, features, respectively, for a total of 108 possible classes (3*6*6 = 108). The ‘‘edge shape’’ paradigmatic classification included four dimensions, with four, three, three, and three features, respectively, also for a total of 108 possible classes (4*3*3*3 = 108). (For details on the dimensions and features of the paradigmatic classifications used here, see the Materials S1 and Figures S6, S7, S8, S9, S10, S11, S12, S13, S14, S15, S16.).

When the Chao1 estimator was used to estimate paradigmatic class richness, an impossible estimate emerged: the upper 95% confidence interval of class richness sometimes exceeded the maximum number of possible classes (Tables 1 and 2, column 8) This discrepancy indicated to us that a new method was needed to address richness estimation when both upper and lower bounds are known. We introduce here doubly-bounded confidence intervals for class richness.

II. METHODS

A new method for estimating class richness is introduced in this literature study such as doubly-bounded confidence intervals; and specifically illustrate new method using the Chao1 estimator, rarefaction, and extrapolation, and shows a demonstration that singly-bounded richness estimators can yield confidence intervals with upper bound estimates larger than the possible maximum number of classes, while that new method provides estimates that make empirical sense, also specifically illustrates a new method using the Chao1 estimator ([14]), however any estimator of class richness can be used in that method. Says that S be the true unknown class richness of the assemblage and let S_{obs} be the number of observed classes in an empirical sample of size n from the assemblage, that called the reference sample. It is assumed that the fixed maximum for S is U.

The observed richness in the sample is likely to substantially underestimate the true richness, if an assemblage includes a non-negligible proportion of rare classes that may remain undetected in a sample of limited size. The abundant classes, which are virtually certain to be detected in samples, contain almost no information about the undetected classes, whereas rare classes, which are likely to be either undetected or infrequently detected, contain almost all the information about the number of undetected classes. The abundance frequency count f_k is defined as the number of classes each represented by exactly k artifacts in the reference sample, $0 \le k \le n$. The number of classes present in the assemblage but not detected in the reference sample is thus represented as f_0.

The Chao1 estimator uses only the number of singletons (f_1) and doubletons (f_2) and the observed richness to obtain the following estimator for the class richness ([14]):

$$\hat{S} = \begin{cases} S_{obs} + f_1^2/(2f_2) & , if\ f_2 > 0 \\ S_{obs} + f_1(f_1-1)/2 & , if\ f_2 = 0 \end{cases} \quad \text{.........} (1)$$

with an associated variance estimator of (if $f_2 > 0$): $var(\hat{S}) = f_2\left[\frac{1}{2}\left(\frac{f_1}{f_2}\right)^2 + \left(\frac{f_1}{f_2}\right)^3 + \frac{1}{4}\left(\frac{f_1}{f_2}\right)^4\right]$ ………...…...… (2)

If $f_2 = 0$, the variance formula (2) becomes: $var(\hat{S}) = \frac{f_1(f_1-1)}{2} + \frac{f_1(2f_1-1)^2}{4} - \frac{f_1^4}{4\hat{S}}$ ……………………..…….. (2a)

It is showed by Chao et al. ([42]) that under many class abundance distributions, the Chao1 estimator, originally derived as an estimate of minimum possible richness, is very sharp if the reference sample size is large enough. From a statistical point of view, the information about a fixed maximum does not help find a more accurate nonparametric point estimator for class richness, but it can be incorporated into the construction of a confidence interval such that the upper limit of the resulting interval is at most the maximum value U.

Table 1. The Chao1 estimate for tool class data, its standard error, and
the 95% confidence interval for each of the seven sites.

Site	n	S_{obs}	Singleton	Doubletons	Chao1 estimate	Standard error	95% confidence interval
Arc	134	31	12	7	41.28	7.78	33.74 – 69.48
Butler	63	23	9	6	29.75	5.88	24.54 – 52.44
Gainey	31	23	16	6	44.33	14.52	29.36 – 94.51
Leavitt	33	220	14	2	69.00	43.99	30.85 – 241.14
Paleo Crossing	159	25	8	4	33.00	7.48	26.69 – 62.84
Potts	41	20	10	3	36.66	14.84	32.72 – 94.54
Udora	97	31	17	6	56.08	16.03	39.34 – 110.96

The last column, obtained from Eq. (4), shows that the upper limits of the 95% confidence intervals for Leavitt and Udora Sites (boldfaced) exceeded the maximum possible value of 108

Table 2. The Chao1 estimate for edge class data, its standard error, and
the 95% confidence interval for each of the seven sites.

Site	n	S_{obs}	Singleton	Doubletons	Chao1 estimate	Standard error	95% confidence interval
Arc	134	31	12	7	41.28	7.78	33.74 – 69.48
Butler	63	23	9	6	29.75	5.88	24.54 – 52.44
Gainey	31	23	16	6	44.33	14.52	29.36 – 94.51
Leavitt	33	220	14	2	69.00	43.99	30.85 – 241.14
Paleo Crossing	159	25	8	4	33.00	7.48	26.69 – 62.84
Potts	41	20	10	3	36.66	14.84	32.72 – 94.54
Udora	97	31	17	6	56.08	16.03	39.34 – 110.96

The last column, obtained from Eq. (4), shows that the upper limits of the 95% confidence interval of all sites except for Gainey and Potts (boldfaced) exceed the maximum possible value of 108.

Bootstrapping is an approximation method that is widely used to assess sampling variability and to obtain confidence intervals for complicated estimators ([43];[44]). To regard the reference sample of n artifacts that we collected as an ‘‘assemblage’’ and generate a series of bootstrap samples by randomly selecting n artifacts, with replacement, from the reference sample, we could calculate a Chao1 estimate of class richness, called a bootstrap estimate S^*. We first review the method to construct a singly-bounded confidence interval with the lower bound no less than the observed richness. In most applications, the distribution for the undetected number of classes is right skewed, thus it is reasonable to assume a log-normal distribution for the number of undetected classes. It can be assumed that $Y = log(S^* - S_{obs})$ is a

normal distribution with mean $\mu_y = log\ (\hat{S} - S_{obs})$ and variance σ^2. It follows from the properties of a log-normal distribution : $\sigma^2 = log\left[1 + \ var(\hat{S})/(\hat{S} - S_{obs})^2\right]$ .... (3)
so a 95% confidence interval for class richness is ([41]) $\left[S_{obs} + (\hat{S} - S_{obs})/c\ , S_{obs} + (\hat{S} - S_{obs})c\ \right]$ (4)
where $c = exp(1.96\sigma) = exp\left(1.96\left\{log\left[1 + \frac{var(\hat{S})}{(\hat{S}-S_{obs})^2}\right]\right\}^{1/2}\right)$, and $var(\hat{S})$ is given in Eq. (2). The lower limit of the resulting confidence interval is not lower than the observed class richness. In the last column of Tables 1 and 2, we show the confidence interval computed from Eq. (4) for each site. However, as explained earlier, some of the upper limits exceed the maximum value of 108. This literature study proposes a new analytic method based on the bootstrap idea to incorporate the maximum value U in the construction of confidence intervals, yielding a doubly-bounded confidence interval. Since any sensible estimate S* should satisfy $S_{obs} \le S^* \le U$, equivalently, all reasonable values of $Y = log(S^* - S_{obs})$ should be less or equal to $V = log(U - S_{obs})$. Therefore, instead of the usual normal distribution, the distribution of Y follows a

Table 3. Comparison of traditional (singly-bounded) and new (doubly-bounded) confidence intervals for tool class data (the doubly-bounded interval is obtained from Eq. 5).

Site	Traditional 95% Confidence Interval	New 95% Confidence Interval
Arc	33.74 – 69.48	33.75 – 68.90
Butler	24.54 – 52.44	24.55 – 52.31
Gainey	29.36 – 94.51	29.34 – 87.14
Leavitt	30.85 – 241.14	30.01 – 103.80
Paleo Crossing	26.69 – 62.84	26.69 – 62.08
Potts	32.72 – 94.54	23.71 – 83.88
Udora	39.34 – 110.96	39.29 – 96.05

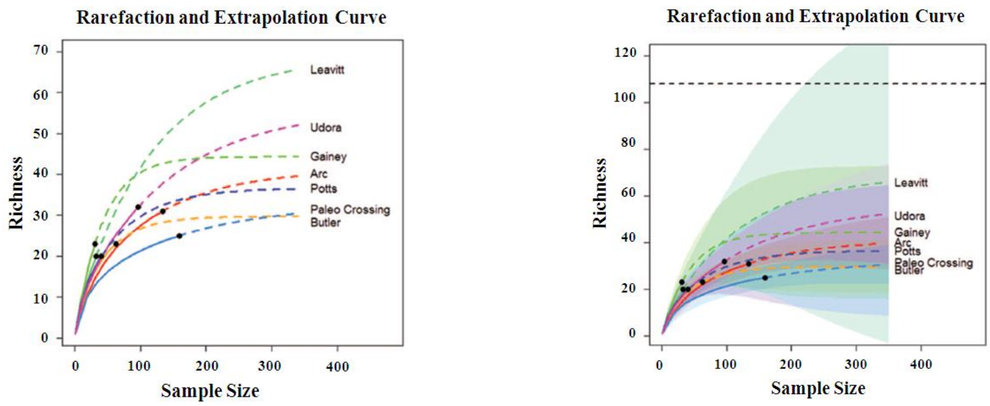

Figure 2. Rarefaction and extrapolation curves (upper panel) for tool class data from seven sites, with symmetric 95% confidence intervals (lower panel) based on Colwell et al. [3]. Black dots: the reference (empirical) samples. Solid lines: rarefaction curves. Dashed lines: extrapolation curves. Shaded area for each solid line: 95% confidence interval for the expected rarefied class richness. Shaded area for each dashed line: 95% confidence interval for the expected extrapolated class richness up to a sample size of 350

''truncated'' distribution with the following density function (here ''truncated'' means that we only consider those Y values less than or equal to V.). $h_Y(y) = \frac{\phi\left(\frac{y-\mu_Y}{\sigma}\right)}{\Phi\left(\frac{V-\mu_Y}{\sigma}\right)}$ where ϕ : the probability density function and Φ: cumulative distribution function of the standard normal distribution. Let $p = \Phi\left(\frac{V-\mu_y}{\sigma}\right)$, then a $1-\alpha$ confidence interval for $log(S - S_{obs})$ is $\left[\mu_y + \sigma Z_{p\alpha/2,}\ \mu_y + \sigma Z_{p(1-\alpha/2)}\right]$, where z_α is a lower percentile point of a standard normal distribution, i.e., $\Phi(z_\alpha) = \alpha$ and σ is defined in Eq. (3).

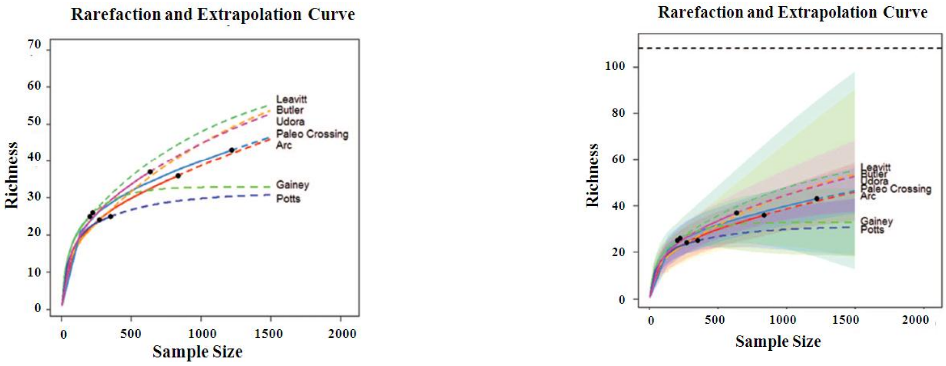

Figure 3. Rarefaction and extrapolation curve (upper panel) of seven sites for edge class data with symmetric 95% confidence intervals (lower panel) based on Colwell et al. [3]. Black dots: the reference (empirical) samples. Solid lines: rarefaction curves. Dashed lines: extrapolation curves. Shaded area for each solid line: 95% confidence interval for the expected rarefied class richness. Shaded area for each dashed line: 95% confidence interval for the expected extrapolated class richness up to a sample size of 1500

As a result, the $1-\alpha$ a confidence interval for S is

$$\left[S_{obs} + \left(\hat{S} - S_{obs}\right)e^{\sigma z_{p\alpha/2}}, S_{obs} + \left(\hat{S} - S_{obs}\right)e^{\sigma z_{p(1-\alpha/2)}}\ \right] \text{...} (5)$$

The intervals in Equations (4) and (5) are both non-symmetric with respect to the richness estimate due to the log-transformation.

In the online Supporting Information (see Appendix S_1 and Table S_1 (spreadsheet)), using the edge class data for the Udora site (Table 2), we provide full calculation details to illustrate how to compute the new, doubly-bounded confidence interval. The traditional interval, Eq. (4), yields a 95%confidence interval of (46.55, 184.15) for which the upper limit exceeds 108. The new method, Eq. (5), yields a 95% confidence interval of (46.02, 104.36). Hence this example shows that the lower limit of the new interval is at least the observed class richness, while, simultaneously, the upper limit is less than 108. The doubly-bounded confidence interval for each site is shown in Tables 3 and 4.

A. *Interpolation (Rarefaction) and Extrapolation.*

Species richness estimators aim to estimate an asymptotic value, approached as the sample size tends to infinity. Colwell et al. ([3]) recently linked interpolation and extrapolation curves as a smooth curve. This curve provides useful information on comparing species richness for finite sample sizes. The goal of rarefaction is to estimate the expected number of classes $S(m)$ in a random set of m individuals from the reference sample ($m < n$). Suppose the observed class abundance for the ith class is denoted by X_i. Then a minimum variance unbiased estimator (Smith and Grassle 1977) for S(m) is. $\hat{S}(m) = S_{obs} - \sum_{X_i>0}\left[\binom{n-X_i}{m}/\binom{n}{m}\right]$. Colwell et al. ([3]) obtained an approximate unconditional variance estimator $var(\hat{S}(m))$ of the rarefied richness $\hat{S}(m)$. A traditional, symmetric 95% confidence interval is constructed by using $\hat{S}(m) \pm 1.96se\left(\hat{S}(m)\right)$The goal of extrapolation is to estimate the expected number of classes $S(n+m^*)$ in an augmented sample of $n+m^*$ individuals from the assemblage ($m^* > 0$). Shen et al. ([46]) derived the following estimator of $S(n+m^*)$:

$$\breve{S}(n+m^*) = S_{obs} + \hat{f}_0\left[1-\left(1-\frac{f_1}{n\hat{f}_0}\right)^{m^*}\right] \approx S_{obs} + \hat{f}_0\left[1-e^{\left(-\frac{m^* f_1}{n\hat{f}_0}\right)}\right] \text{......................................} (6)$$

where $\hat{f}_0 = f_1^2/(2f_2)$ based on the Chao1 estimator. A variance estimator $var\ \breve{S}(n+m^*)$ was also derived by Shen et al. ([45]). A symmetric 95% confidence interval for extrapolation is constructed as

$$\breve{S}(n+m^*) \pm 1.96\ se\left(\breve{S}(n+m^*)\right)$$

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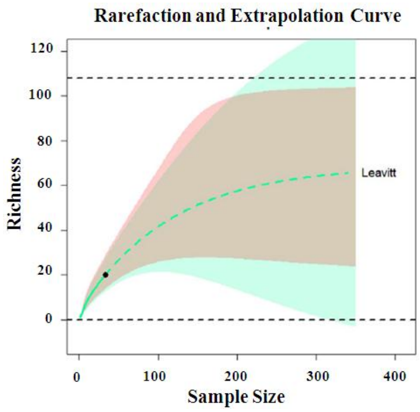

Figure 4. Comparison of the symmetric intervals (wider intervals, as in Figure 2) and the doubly-bounded confidence interval for tool class data from Leavitt Site. The symmetric intervals were obtained based on Colwell et al. [3] and the doubly-bounded intervals were computed from Equations (7) and (8). The intervals unavoidably tend to be wide due to the small sample size (n = 33) for the site. Long-range extrapolation is applied only to illustrate the behavior or the bounded confidence interval.

In Figure 2, we show the plots of rarefaction and extrapolation for tool class data from seven sites. The corresponding plots for edge class data are shown in Figure 3. In Figure 2, the upper limit of the traditional symmetric 95% confidence interval of the predicted class richness for the Leavitt Site is greater than the maximum value of 108 when sample size exceeds 200. We now briefly describe the modifications required for the confidence interval of the extrapolation part of the curve, when when there is a fixed maximum value for class richness. If we assume that the logarithm of bootstrap estimates of $S(n+m^*)$ is a normal distribution truncated by $log(U)$, then a parallel derivation to that in Section 3 for obtaining Equation (5) yields a $1-\alpha$ a confidence interval for $S(n+m^*)$ given by.

$[\tilde{S}(n+m^*)e^{\sigma_1 z_{p1\alpha/2}}, \tilde{S}(n+m^*)e^{\sigma_1 z_{p(1-\alpha/2)}}]$ .. (7)

di mana

$\sigma_1^2 = log\left\{1 + var\tilde{S}(n+m^*)/[\tilde{S}(n+m^*)]^2\right\}$

…(7a)

and p_1 is defined $p_1 = \Phi\left(\frac{logU - log\tilde{S}(n+m^*)}{\sigma_1}\right)$. A similar approach can be also applied to the rarefaction part of the curve simply by replacing $\tilde{S}(n+m^*)$and its variance by $\tilde{S}(m)$ and its variance. Thus, the $1-\alpha$ confidence interval for $S(m)$ is $[\tilde{S}(m)\,e^{\sigma_2 z_{p2\alpha/2}}, \tilde{S}(m)\,e^{\sigma_2 z_{p2(1-\alpha/2)}}]$ …….........…………………… (8)

where $\sigma_2^2 = log\left\{1 + var\tilde{S}(m)/[\tilde{S}(m)]^2\right\}$ …...…………………………………………… (8a)

dan p_2 is defined as $p_2 = \Phi\left(\frac{\log U - \log \tilde{S}(m)}{\sigma_2}\right)$. In Figure 4, we single out the Leavitt Site to compare the original symmetric and the modified confidence intervals. The sample size for tool class in Leavitt Site is only 33, thus the variance of the Chao1 estimator is the largest of the seven sites. When we extrapolate to 350, it is unavoidable that the confidence intervals become wide. The comparison of seven sites with the modified confidence intervals are shown in Figure 5 for tool class data and in Figure 6 for edge class data. It is clear that for any finite sample sizes, all seven intervals overlap substantially. Although slight overlap may not imply significance, the considerable overlap among these confidence intervals indicates that the current data do not support any significant difference in class richness, among the seven sites.

III. RESULTS

Based on the work of Bettinger ([46]), Schiffer ([47]), and Surovell ([48]), Eren ([39]) proposed that different forager base camp settlement patterns would be corroborated by different levels of tool class and edge class richness, by the pattern of relative abundance among classes, and by the classes represented in artifact assemblages (see also [49];[50];[51];[52];[53];[54]). In regard to richness only, a residential forager settlement pattern (moving a base camp across the landscape short distances, but frequently, to complete different subsistence tasks) would be supported if the unifacial stone tool class and edge class richness differed significantly among the seven base camp sites. The rationale behind this inference is that a sample of base camp sites used by a group of foragers following a residential mobility strategy would be less likely to exhibit the same scope of tool-using activities (and thus tool class and edge class richness) at all sites, since each is positioned in a unique location across a landscape for a different subsistence purpose. Alternatively, a logistical forager settlement pattern (moving a base camp far across the landscape, but less often) would be supported if tool class and edge class richness varied little among sites. In a logistical mobility strategy, base camps are occupied for much longer periods, requiring relatively more subsistence tasks to eventually be completed at a single location. If so, a sample of logistical base camp sites is more likely to reveal similar spectra of tool-using activities (and thus tool and edge class richness), as the same wide scope of activities will be eventually carried out at each. The original 95% confidence intervals of the seven base camp sites' tool and edge class richness (Table 3 and 4, column 1, Figures 2 and 3) did not allow any inference about forager settlement patterns because they did not make any empirical or logical sense. However, with confidence intervals constrained by the maximum class richness (Table 3 and 4, column 1, Figures 5 and 6), it is now clear that the new 95%confidence intervals overlap substantially, suggesting that tool class and edge class richness do not vary significantly among the sites. Our conclusion is justified from both asymptotic richness estimation (Table 3 and 4) and rarefaction-extrapolation methodology (Figures 5 and 6). On its own this result supports the notion that Late PleistoceneClovis foragers in theLowerGreatLakes used a base camp settlement pattern that was probably more logistical in nature than residential, though future assessments should consider this result among a suite of other diversity measures and archaeological evidence. The applicability of our new method is not limited to archaeology or paradigmatic classification. Indeed, it can be applied to any set of data for which there is a fixed maximum number of classes

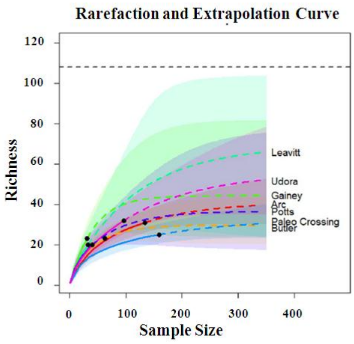

Figure 5. Rarefaction and extrapolation curves for tool class data from seven sites with doubly-bounded 95% confidence intervals based on Equations (7) and (8). Black dots: reference samples. Solid lines: rarefaction curves. Dashed lines: extrapolation curves. Shaded area for each solid line: 95% confidence interval for the expected rarefied class richness. Shaded area for each dashed line: 95% confidence interval for the expected extrapolated class richness up to a sample size of 350

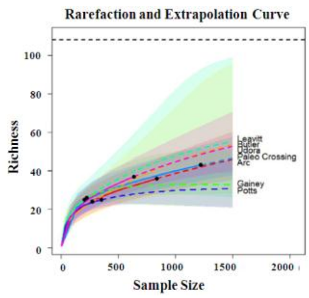

Figure 6. Rarefaction and extrapolation curves for edge class data from seven sites with doubly-bounded 95% confidence intervals based on Equations (7) and (8). Black dots: reference samples. Solid lines: rarefaction curves. Dashed lines: extrapolation curves. Shaded area for each solid line: 95% confidence interval for the expected rarefied class richness. Shaded area for each dashed line: 95% confidence interval for the expected extrapolated class richness up to a sample size of 1500.

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A. Site Occupancy Models

In site occupancy models ([55]), a fixed maximum number of U sites may either be occupied or unoccupied by a member of each class. The site occupancy rate can be estimated by Sest/U, where Sest is interpreted as the estimated number of sites at which the class is present.

B. A Marketing Example

Our new method (Equations 1 and 5) can provide an appropriate estimate with sensible confidence intervals.

C. A Census Example

The application of our estimators would allow for an assessment of true sociocultural richness for each place, based on limited sampling, that would not otherwise be practical.

IV. CONCLUSIONS

New method in this paper is not limited to archaeological applications. It can be applied to any set of data for which there is a fixed maximum number of classes, whether that be site occupancy models, commercial products.

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THE BIODIVERSITY 0F HOMEGARDEN AS A FAMILY SURVIVAL AND A BASIS OF TOURISM DEVELOPMENT

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Abstract — Indonesia is a megadiversity country because of the plants and animals biodiversity. The Changes in socio-economic conditions have affected the community orientation from subsistence to commercial, so that it affected to the type of crops cultivated in home gardens (Arifin, et al., 2012; Mohri et al., 2013). This research aims to understand the role of biodiversity in home gardens in sustaining family life and developing tourism. The research was conducted in Manggungsari, Wonokerto, Turi and Ketingan, Tirtoadi, Mlati, Sleman, where are each of villages had taken 20 respondents randomly. The methods to collect data were through observation, questionnaires and in-depth interviewing with respondents and community leaders, and identifying the diversity of cultivated plants and husbandry animals. Data were analyzed with vegetations analysis about the important values and the Shannon-Wiener diversity index, cross-tabulations, and descriptive analysis. The results showed that in Manggungsari, Turi, the plant that has the highest important value is *Sallaca edulis* (58.81%) with 1.89 for the Shannon-Wiener plant species diversity index. It is due to the dominance of *Sallaca edulis* has became major income sources for people in Manggungsari, Turi. In Ketingan, Mlati, *Musa acuminata balbisiana* Colla (6.42%) has the highest important value with 4.58 for the Shannon-Wiener plant species diversity index, including high-value category (1 < 4,58 < 3). The highest important value for Fauna in Manggungsari, Turi, is *chicken* (46.5%) with 2.46 for the Shannon-Wiener animal species diversity index. In Ketingan, Mlati, *Egretta alba* (89.91%) has the highest important value with 1.19 for the Shannon-Wiener animal species diversity index. It is due to the dominance of *Egretta alba* there. This value included in the medium category approach low (the low-approach-medium category) or the ecosystem condition is adequate (still quite) balanced but unsteady. Their excellence plant made Manggungsari, Turi, known as an agro-tourism of Sallaca edulis, as well as their dominance of *Egretta alba* in Ketingan, Mlati which made the village known as a fauna-tourism village of *Egretta alba.* The advantages (excellence) of plants and animals that possessed both of the villages can develop the village as a tourist village.
Keywords*: biodiversity, homegardens, survival and tourism development*

I. INTRODUCTION

The biodiversity in homegardens are part of the global biodiversity of our nation and have an important role for a community's life. In terms of ecology, the homegarden is an area with an integrated system and has a strong relationship between the human being as an owner with crops, plants, fish, wildlife and animals are cultivated, in addition to the diversity of plants and animals in homegardens also has a function in the interests of social, cultural and religious (Danoesastro, 1977, Soenoeadji, 1983 and Arifin et al., 2009). The homegarden is also often referred to as the granary of life (food source of life such as food crops and horticulture, the results of pets and fish), tavern life (different kinds of plants and animals are at all times ready for sale for family purposes) and herb (various types of plants drugs that can be used for traditional medicines are efficacious (Danoesastro, 1977 and Soemarno, 2011), so the homegardens has the potential to increase incomes and families meet the nutritional needs, so the homegardens is able to contribute the public income between 4.47% - 61% (Soenoeadji, 1983; Yulida, 2012 and Saptana, 2014).

The choice of plants and animals are cultivated in homegardens is strongly influenced by land management purposes by the owner both in terms of economic, social, cultural, religious, comfort and satisfaction as well as the economic value of a crop and animal products. Changes in socio-economic conditions have affected the orientation of farmers in managing the diversity of plants in their homegardens of subsistence to the commercial so the effect on the number of plant species cultivated in homegardens (Kehlenbeck, et al. (2007), Arifin, et al. (2012). Mohri et al. (2013), Piyre, et al. (2006).

The biodiversity of plants and animals have important value in an area that can be seen both from the number of species of plants and animals as well as the number of individuals of each species of plants and animals are cultivated by farmers, so that the same plant may not necessarily have equal importance value in the region different. In addition, it can be seen from the use of plants and animals by the people to meet the needs of daily life and to develop the villages, therefore, this study aims to assess the potential of biodiversity both seen from the significance, benefits in contributing to family income as well as plants and animals that are the hallmark of products to be used as a tourist attraction of plants and animals cultivated or wild living.

II. ESEARCH METHODS

This study uses a combination approach, which is a quantitative approach while also using a qualitative approach (Sugiyono, 2013). A Quantitative approaches are used to assess the biological diversity of both plant and animal and qualitative approaches to assess the characteristics of social, economic and cultural community in utilizing biodiversity in home gardens both to increase family income and to increase the potential of village. Determination of the village is used purposive sampling. It is based on a village that has featured both of plants and animals cultivated or wild life in Sleman. Furthermore, every village taken one hamlet in the same way and every hamlet of 20 families were taken as respondents randomly (Singarimbun and Effendi, 1989). Based on this method were selected as sample village is Hamlet Manggungsari, Wonokerto, Turi which has featured plants of *Sallaca edulis* and Hamlet Ketingan, Tirtoadi, Mlati which have featured wild animals of *Egretta alba*. Methods of data collection is done through observation, interviews, questionnaires and in-depth interviews with respondents and community leaders as well as the identification of plant and animal diversity. Further analysis of benefits and vegetation analysis by calculating the density, relative density, frequency, relative frequency, and the important value of plants and animals. In addition it also conducted vegetation analysis by counting the Shannon-Wiener index of species diversity (H '), uniformity index (E) and richness Index (R1). (Soerianegara and Indrawan 2005, Odum, 1993; and Setiadi, et al., 1989).

III. RESULTS AND DISCUSSION

A. *The Role of The Biodiversity In homegardens Based on Important Value of plants and animals and the Benefits In Families Life Sustainable*

The Important value can be used to determine the dominance of a plant or animal species to others species that describes ecological notch a plant or animal species in the community (Mueller-Dombois and Ellenberg, 1974). Based on the results of analysis show that the important value of plant species ranged from 0.15% - 59.81% to the highest important value is *Sallaca edulis*, while the important value of animals ranged between 1.08% - 89.91% to the highest important value is wild birds *Egratta alba* in Ketingan, Mlati. The number of plant species ranging between 191-196 species, with a number of individuals ranging between 3094-17358 individual plants. Based on Shannon Wiener index diversity value of plants (H ') in Ketingan, Mlati obtained indices the diversity of plants in the high category (> 3) that is equal to 4:58 and in Manggungsari, Wonokerto, Turi, the value diversity index of 1.89 is included in the medium category. The medium Value due to the dominant plant in Turi is *Sallaca edulis*. *Sallaca edulis* in Turi has important value is very high at 59.81%. This is because Sallaca edulis become a major income source community in Turi, so plants are less productive and do not have a lot of economic value are replaced with plants of S*allaca edulis.*

The results showed the number of species of fauna in Ketingan as many as 25 kinds with 1084 individuals and animal species diversity index of 1.19, while in Manggungsari, Wonokerto as many as 23 species with 228 individuals and animal species diversity index of 2.46. Based on the value of Shannon Wiener diversity index (H ') of animal species has a value that is medium classified (Odum, 1993). In the hamlet of Ketingan there are animals that dominate is *Egretta alba*. The presence of wild animals that dominates cause the value of animal species diversity index approaching the lower categories, namely 1,19, even the important value of *Egretta alba* reached 89.91%.

Besides the type of plant, people in Sleman too many cattle to seek revenue sources, increase revenue, or to meet the needs of daily life of the family. Cattle that are commonly is beef (Hamlet Ketingan, Tirtoadi), goats (Hamlet Manggungsari, Wonokerto), chickens, ducks and wild duck. In addition, some small communities work on the fish in the pond located in homegardens. Of the cultivated cattle can be produced meat, milk and eggs. Meat and dairy plays an important role in meeting the food needs according Dietary Pattern of Good Hope, which is one element of animal food. (Ministry of Agriculture, 2012).

The potential biodiversity based on benefits can be classified as food crops, fruits, vegetables, coloring and flavoring, ornamental plants, medicinal plants, plantation plant, and building materials plants, handicrafts plants, wood plants and others, while the animals can be classified as economically valuable animals, pets and animals for pleasure and wildlife.

In the grouping based on these benefits, there is a type of plant that can have dual functionality both as a medicinal plant, or as ornamental plants, such as leaves of red betel.. Likewise, there is a plant that belongs to the group of vegetables, but also as an alternative food ingredient, eg breadfruit. Breadfruit can be used as an alternative source of food substitution of rice for carbohydrates contained in 100 g breadfruit flour equivalent to 100 g rice (Supriati 2010) and substitutes the use of wheat (Djaafar and Siti Rahayu, 2005).

Utilization of plant based on important values in Manggungsari and Ketingan Hamlet can be seen in Table 1.

Table 1. Utilization of Plant Community Based Important Value (INP)

No	**Grouping**		**Hamlet of Manggungsari, Turi**		**Hamlet of Ketingan, Mlati**	
			Type of plant	NP (%)	Type of plant	NP (%)
1.	crops	3 biggest	*Monihot utilisima*	2,74	*Monihot utilisima*	3,02
			Calocasia esculenta	1,76	*Calocasia esculenta*	2,33
			Canna edulis	0,80	*Canna edulis*	0,79
2	fruits	3 biggest	*Sallaca edulis*	59,81	*Musa balbisiana*	6,42
			Musa balbisiana	2,32	*Nephelium lappaceum*	4,45
			Artocarpus heterophyllus	2,20	*Carica papaya*	3,84
3	vegetables	3 biggest	*Capsicum frutescens*	21,86	*Amaranthus hybridus*	2,99
			Brassica campestri	4,71	*Sauropus adrogynus*	1,71
			Phaseolus vulgaris	1,99	*Pandanus amaryllifolius*	1,31
4	plantation or indus-trial plants	3 biggest	*Gnetum gnemon*	1,35	*Gnetum gnemon*	5,16
			Ricinus communis.	0,53	*Theobroma cacao*	0,89
			Syzygium aromaticum	0,47	*Coffea arabica*	0,49
5	ornamental plants	3 biggest	*Codiaeum variegatum*	1,81	*Sansevieria trifasciata*	5,45
			Sansevieria trifasciata	1,56	*Euphorbia* sp.	4,72
			Euphorbia sp.	1,34	*Adenium* sp.	3,77
6	medicinal plants	3 biggest	*Zingiber officinale*	1.50	*Alpinia galanga*	1,98
			Alpinia galanga	1,27	*Zingiber aromaticum*	1,79
			Citrus aurantifolia	1,06	*Aloe vera*	1,22
7	plants for building.	3 biggest	*Albisia* sp.	3,18	*Giganthochloa apus*	5.68
			Swietenia mahagoni	2,39	*Swietenia mahagoni*	4,29
			Glyricidia sepium	2,01	*Cocos nucifera*	3,31
8	plants for culture	3 biggest	*Sallaca edulis*	59,81	*Cocos nucifera*	3,31
			Cocos nucifera	2,38	*Codiaeum variegatum*	2,82
			Codiaeum variegatum	1,81	*Chrysalidocarpus lutescens*	1,66

Source: The Primary Data Analysis

Based on Table 1 note that for food crops, cassava has a high importance in both locations. This is because in addition to cassava as a food crop leaves are also used as a vegetable that is appreciated by the community. Fruit of *Sallaca edulis* in Turi has important value 59.81%, this was due Sallaca edulis is a plant which became a major source of income in Turi. Fruits that have a high importance in both locations was the banana, it is because banana breeding through shoots quickly form clumps without having to plant a new crop. In addition, bananas kapok is also favored by the people to serve fried bananas, Molen or boiled.

Plant vegetables that have high economic value in Manggungsari Turi is a chili that has important value of 21.86%. This is because the chili in Turi is a plant that is generating income after *Sallaca edulis*, while the chili in Ketingan planted community in homegardens is not for sale but for self-sufficient. As for plantation or industrial plants, Gnetum gnemon dominate at both locations. This is because the fruit Gnetum gnemon have economic value and easy to sell. Traders of Gnetum gnemon fruit in its season will come to a citizen to purchase Gnetum gnemon (nebas) so that people feel disadvantaged by planting Gnetum gnemon. In one year Gnetum gnemon plants can produce fruit twice.

The community activities are related to the cultivation of plants and animals in homegardens in addition to supplement the family income is also closely related to the role of plants and animals in people's lives, such as for initial steps disease prevention, cultural activities followed all citizens, or by a family in the life cycle (births, marriages and deaths).

In addition to plants, people also raise animals that have economic value as beef (Ketingan, Mlati) and goats (Manggungsari, Wonokerto) were all in the form of fattening, after fat or big it will be sold and bought again smaller with more number to be raised again. The family sold the animals ahead of Eid al-Adha, thus raising goats and cows can be a family's savings. Other animals that are kept are cats, dogs, canaries were all in the form of pets and can give pleasure to the family. Dogs kept apart to give pleasure can also help keep the house so that if there are foreigners who come already barking first.

Pet who score the highest importance in both locations was a chicken (from 36.8 to 46.5%), and this is because almost all of the peoples raise chickens for the purpose of eating leftovers family, to produce eggs for family purposes or slaughtered when needed family. As for the wild animals that have a high important value is the *Egretta alba* in the hamlet of Ketingan, Tirtoadi, Mlati which reached 89.9%, so that this animal has its own advantages for Hamlet of Ketingan. To preserve the *Egretta alba*, the community provides comfort by planting crops that became a favorite the *Egretta alba* perched like mahogany and bamboo as well as prohibiting people who are poaching the *Egretta alba*

In daily life in the countryside can not be separated with cultural activities that take advantage of biodiversity as a manifestation of human relationships, whether it is man's relationship with God as the religious event (Eid al-Adha, Christmas with fir tree, Palm Sunday with palm leaves, assortment of flowers on a Hindu religious ceremony), the relationship between humans at weddings, births and deaths are all using plants. Man's relationship with each other as in a wedding event is marked by a variety of foliage as leaf croton in a twin Mayang, sugarcane wulung, fruit plantain on Tarub, merti earth with a variety of produce from home gardens as a form of thanksgiving and invoking the protection of God, banquet (feast relating to births, marriages, seven monthly, death), wiwitan as thanksgiving for rice that has been ready for harvest using bark plants, Pulutan, artocarpus camansi. Man's relationship with the people who have died, for example, sow a wide variety of flowers on the tomb like rose, jasmine, ylang-ylang, magnolia and telasih.

B. Role of Biodiversity Based Product Advantages To Develop Tourism

Livelihood or their livelihoods greatly influence the choice of plants and animals grown in home gardens. People in the hamlet Manggungsari, Turi, the majority still rely necessities of life on land owned, so the land becomes very important both to support their daily living and to satisfy all their needs in various aspects of life of short-term and long-term by utilizing livestock or cultivated plants is primarily by planting pondoh and chilli and raise goats as the main source of income.

In areas are closer to urban areas, namely in Ketingan, Mlati, some people have wetland and also working as an employee, then either plants or animals that are cultivated or wild not be the primary source of revenue to sustain life. The presence of wild animals are huge numbers, were able to provide additional income for the community because of the existence of these animals attract many people to come see it so Dusun Ketingan into a tourist village fauna. This happens in Hamlet Ketingan, Tirtoadi, Mlati, Sleman, where the village is home to Egretta alba Egretta alba like the place to stay and nest, especially at the beginning of the rainy season until the beginning of the dry season. In the season Egretta alba easy foraging in the area and its surroundings because many people who grow rice so much food available for birds kuntl. , The change of season is also sometimes shifted the presence of Egretta alba in the hamlet Ketingan, it is sometimes for people less profitable, because the village board has been willing to accept vacationers turns at the specified time Egretta alba have not come to the hamlet Ketingan so vacationers coming void visit. There are three types of herons who live in Ketingan namely:

1. Little *Egretta alba (Egretta garzetta*) with the characteristics of her rather large and slender, larger than the buffalo herons. In the breeding season, this bird has two thin white ornamental feathers

elongated on the back of his neck. Legs and feet are black. Like little *Egretta alba* foraging in the fields and eat many kinds of fish, tadpoles, water insects and grasshoppers.

2. Great *Egretta alba (Egretta alba)* with the characteristics of large-sized body. Much larger than the white herons, typical knotted neck, black legs, yellow beaks are usually tipped black, black feet and legs, live alone or in groups, stand a little straighter and peck prey encountered. These birds eat fish, shrimp, grasshopper, dragonfly larvae that inhabit the rice fields
3. *Buffalo Egretta alba (Bubulcus Ibis)* with the characteristics of small, white fur, but during the mating season, the feathers on the head, neck and back are yellow orange. Yellow beak and thicker than other herons and black legs. Bubulcus ibis foraging in fields and rice paddies as fish, frogs, invertebrates, insects. Herons buffalo in Indonesia, including the species of birds that are protected by the Act through 1931 No. PP Wild Animals 266, SK Mentan No. 301 / Kpts- 11/1991 and Law No. 5 of 1990 (Aldio 2004, Noerjito and Maryanto, 2001)

In addition to the three types of Egretta alba in above Ketingan above there are also blekok birds (*Ardeola speciosa*) is a discrete body length of about 46 cm. Part of yellow and black on the ends. During the non-breeding brown color backs. These birds foraging in the fields such as insects, fish, and crabs. *Egretta alba* have made their village Ketingan increasingly recognized from the outside and the many tourists who come. To increase the attractiveness of tourists, the local community, led by Mr. Haryana complement fauna travel with a package that includes cultural attractions and activities associated with farming in rice fields. Cultural attractions include: a. Gejok dimples played by the PKK, b. Peng Bung namely music using klenting and flute accompanied by dances and c. jathilan, while the events related to agricultural activities, among others: a. plowing fields using cattle to plow and harrow, b. angler ie activities after planting rice with a cone and ingkung (whole chicken) as the hope that a good harvest is not attacked by pests or diseases, c. wiwit, as a form of thanksgiving before the rice harvest, usually done one week before the rice is harvested in the form of rice, sauce sprawl, botok Yuyu (Crab fields) and are equipped with a variety of foliage as the leaves barking as a symbol to refuse reinforcements or pests; Pulutan plant as a symbol of the adhesive, so that the crop is not quickly exhausted; leaf shoots cane as a symbol of steadiness heart, leaves artocarpus camansi as a symbol so that the result is always excessive.

In addition to cultural attractions and activities associated with agriculture, in July also held that merti earth, except the month of fasting coincides month, then postponed event. Such activities as a form of gratitude and thanks to God for the land that has been acquired by the event: jamasan kris, sent to the grave, tirakatan followed by all citizens, Parade around the village and puppet with a story that has to do with bringing home Dewi Sri (rice).

1. Tourism Village Based On Product of Excellence Plant (Agrotourism)

Tourism village based on products of superior plants that are cultivated or agrotourism in this study was found in Wonokerto village, Turi. The village is famous as the agrotourism of *Sallaca edulis*, where visitors can learn how the cultivation of *Sallaca edulis* and can pick their own fruits desired. In addition to the agrotourism, in Wonokerto village also was been built Museum of *Sallaca* "Dewi Pule" which provides information on various things about the cultivation of *Sallaca*, ranging from farmer equipment of *Sallaca edulis*, kinds of *Sallaca sp*., plant pests of *Sallaca sp* preserved in the form of a mounted, processed craft of *Sallaca sp*., processed culinary of *Sallaca s*p and information services on various issues regarding of Sallaca sp. that is located in the hamlet Pulesari, Wonokerto, Turi, Sleman.

The Cultural activities using the fruits of Sallaca is an event “Tunggul Arum” in Wonokerto. In this activity, created a mountain of fruits of Sallaca to complement the cultural activities

2. Tourism Village Based On Fauna

Wild fauna living in an area in Sleman is *Egretta alba* in Hamlet Ketingan, Tirtoadi, Mlati. In this village visitors can find *Egretta alba* perched in various types of leafy trees in front of the gate, along the road in the hamlet Ketingan and in front of the houses of residents. In addition visitors can find the natural atmosphere of the village, visitors can also enjoy a variety of activities and enjoy a wide variety of art and cultural performances special typical of Ketingan. Performances related to the agriculture is starting from dropping directly into soil to grow rice, plowing, wiwit, and harvesting rice yellowed. Furthermore, visitors can enjoy cultural activities and artistic performances special of Ketingan Hamlet, like jathilan, gamelan, wayang kulit and Peng bung are played by locals community. For visitors who want to settle down temporarily, in the village are provided home stay with traditional Javanese house (joglo) is unique and comfortable.

Another interesting thing in Hamlet Ketingan is dreamy and see the activity of white Egretta alba in viewing post. The right time if you want to see Egretta alba was in the morning and evening, in the morning Egretta alba doing activities with blown out with clustered village, whereas in the evening Egretta alba will return home to Hamlet Ketingan. In addition, during the full moon visitors can view the behavior of unique Egretta alba, Egretta alba will fly from afternoon until night above the hamlet Ketingan. Hamlet of Ketingan already become habitat and home to Egretta alba, because of the environmental wisdom of communities to provide a comfortable atmosphere for Egretta alba by planting trees favored by Egretta alba such as mahogany and bamboo.

IV. CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis and discussion, the biodiversity in homegardens has benefits and important values that have the potential to:

a. The biodiversity in homegardens based benefits to plants are classified as food crops, fruits, vegetables, coloring and flavoring, ornamental plants, medicinal plants, plantation crops and building materials plants and crafts. As for the animals grouped in economically valuable animals, pets and wild animals for pleasure.
b. Based on the important values obtained plants with important value is the highest (*Salacca sp.)* And animals with the highest important value is *Egretta alba*. Important value of plants as product excellence has been the primary source of revenue in the hamlet Manggungsari, Wonokerto, Turi in the form of fruits of *Sallaca* as well as a village have become agrotourism of Sallaca edulis. While this type of wild animals Egretta alba that have the highest important value has been able to attract tourists to view thereby increasing people's incomes and simultaneously develop the village into a tourist village of fauna.

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BE – 01

Application Of Problem Based Learning And Inquiri To Gain Creative Thinking And Mastery Of Concepts

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Abstract **—**This study aims at determining differences in the ability to think creatively and mastery of concepts of students based on assessment instruments that acquire problem-based learning and inquiry in SMP Negeri 23 Seluma. This research was conducted in February - March 2015. The method used in this study is a quasi-experimental design study is a Pre-Test Post-Test Control Group Design. The sample of the research was three classess of sevent grade, the determination of the experimental class and control class by random sampling technique. Research data collection used the assessment instrument in the form of test mastery of concepts and creative thinking, while data analysis techniques used in the study are using ANOVA (One Way ANOVA) . The results show that there were significant differences in the application of problem-based learning, inquiry learning and conventional learning to mastery of concepts of biology on the topic of environment at SMPN 23 Seluma . Problem-based learning model is better than learning model Inquiry with the average ratio amounted to 0.833, on mastery of concepts. Inquiry learning model is better than the conventional learning model with the average ratio amounted to 1.833 on the student's ability to think creatively.

***Keywords**: Creative Thinking, Problem Based Learning , concept mastery, inquiry.*

I. INTRODUCTION

In the process of teaching and learning, teachers have a duty to encourage, guide, and provide learning facilities for students to achieve the goal. Teachers have a responsibility to see everything that happens in the classroom to assist in the development of students. Submission of lesson is just one of many activities in learning as a dynamic process in all phases and processes of student progress, for it needs an effort to improve the quality of learning by changing the teacher's role as an information center to act as a facilitator, mediator, and a friend provide conditions conducive to the construction of knowledge and to improve scientific thinking (Slameto, 2006) . The success of a lesson can also be measured by the ability to think and mastery of concept, therefore, the subject matter is clearly to be able to describe the relationship between concepts. A relationship concepts in the subject matter can be described in terms of formulas to solve the problem, charts, posters, pictures, charts, and other forms that can visualize the concept of the subject matter (Dahar, 2005). One of the capabilities that need to be developed to improve thinking skills is creative thinking that aims to develop or find an idea or the results of the original, aesthetic, constructive associated with the view, the concept, the emphasis is on aspects of thinking intuitive and rational, especially in using information and materials to show or explain it with the perspective of original thinkers, (Arnyana, 2006).

In learning innovation as a solution to help the problems in learning in which the student-centered learning is through problem-based learning and inquiry-based learning. This effort is expected to optimize the achievement of creative thinking and improve students' mastery of concepts. Other views of inquiry learning according Irwandi (2010), can involve students actively using the process of science and scientific skills and creative abilities as they find answers to the questions posed. Thus, in inquiry learning students are not only required to master the subject matter, but how they can use their potential, students will be able to develop the capacity to think when he can master the subject matter. Inquiry learning is a form of learning-oriented approach to the process. Say so, for students holding a very dominant role in the learning process (Amier, 2010).

In problem-based learning students can foster problem-solving skills, where students act as problem solvers and learning built in the process of thinking, teamwork, communication and exchanging information (Rusman, 2011). Eggen, (2012), explains that the problem based learning can provide opportunities for students to explore to collect and analyze data to solve the problem, so that students are able to think critically, analytically, systematically and logically in finding alternative solutions masalah.memperoleh something new, manipulating skills and process skills, communication skills, creative skills, and attitudes . According Irwandi (2010), stated that the problem-based learning provides an opportunity to think of empowering learners in the activities of problem solving and decision making in the context of the real world of complex life . Problem-based learning, held by five steps of learning, namely: (1) orient students to the problem, (2) organize students for study, (3) assists independent and group investigation, (4) develop and present artifacts and exhibits), and (5) analyze and Evaluate the problem-solving process).

Biological concept on material management of this environment, studies on prevention and preservation of the environment from pollution, and is directly in student life, environmental issues and pollution need to be overcome, so that the existence of these problems is important for the students are given a problem-based learning and inquiry-second the study looked for a material that has a basic problem that must be solved with each strategy. Thus, learning that is used can improve their understanding of concepts and develop the ability to think creatively. According to (Jalaludin, 2009), the fact the field shows that many students who have difficulty studying biology. This learning difficulties due to the current lack of thinking skills and mastery of concepts of biology students shown by the low learning outcomes of students towards subjects biology.

Student learning outcomes were lower in the subjects of biology, the students of SMP Negeri 23 Seluma, in particular the class VII can be identified as follows: 1) The results of students' mastery of concepts not yet reached the expected target so it needs to be improved. 2) In general, students do not have the ability to develop or add creative ideas to the questions given by the teacher, the students' answer generally tends to focus on the content of the course material that needs to be fostered more creative thinking skills. Biology teachers still dominant conventional learning how to apply, except that the student's ability to absorb the lessons so diverse that retention of material from each of the students to be different. Learning methods are designed teacher has been less attention to it. Susanti (2012), in his research on the influence of problem-based learning and guided inquiry towards mastery of concepts shows that there is significant influence application of problem-based learning, inquiry learning guided and conventional learning to mastery of concepts of biology, and Arnyana (2006), in his research concluded that students who studied Kooperarif strategy with GI , PBL, and inquiry, has the ability to think creatively better than the group of students are are taught by DI models.

II. METHOD

This research was conducted in February - March 2015. The method used in this study is a quasi-experimental design study is a Pre-Test Post-Test Control Group Design. The sample of the research was three classess of sevent grade, the determination of the experimental class and control class by random sampling technique. Research data collection used the assessment instrument in the form of test mastery of concepts and creative thinking, while data analysis techniques used in the study are using ANOVA (One Way ANOVA).

III. RESULT

Statistical description and preliminary analysis score pretest and posttest results mastery of concepts of biology and creative thinking abilities of students.

Sources existence of differences	Number of Squares	Df	mean Squares	F	*Sig.*	H_0
Between groups	4.422	2	2.211	1.297	0.279	Accept
Inter group	148.300	87	1.705			
Total	152.722	89				

table 1. average scores anava pre-test mastery concept of biology

Seen from result of above, the significant value gained 0.279 greater than 0.05. Means mastery of concept of biology pretest results for the third class there was no difference. To determine the difference in mastery of concept of biology of students in the third class derived from the analysis post-test scores. The results of the analysis are shown in table 2 below:

Sources existence of differences	Number of Squares	Df	mean Squares	F	*Sig.*	H_0
Between groups	64.867	2	32.433	22.897	.000	Not accepted
Inter groups	123.233	87	1.416			
Total	188.100	89				

table 2. average scores anava post-test mastery of concept of biology

Seen from result of above, the significant value gained 0.000 less than 0.05. Means mastery of concept of biology posttest results for the third class there is a difference. To know learning models that differ significantly in the mastery of concepts of biology, followed by LSD, the calculation results are presented in Table 3 as follows:

Class		Mean difference	*Sig.*	H_0
PBL	Inkuiri	.833*	.008	Not accepted
	Konvensional	2.067*	.000	Not accepted
Inkuiri	PBL	-.833*	.008	Not accepted
	Konvensional	1.233*	.000	Not accepted
Konvensional	*PBL*	-2.067*	.000	Not accepted
	Inkuiri	-1.233*	.000	

table 3. test scores lsd post test mastery concept of biology

From Table 3, the results of post hoc test for mastery of concepts in PBL, Inquiry and conventional. If sig is smaller than 0.05 means that there is a difference. PBL models with inquiry obtained sig 0008, between PBL models with conventional obtained sig 0000, the inquiry with conventional models obtained 0,000. So from the third class student mastery of concepts is significantly different. It can be concluded based learning and inquiry learning problems differ significantly towards mastery of concepts of biology students

Sources existence of differences	Number of Squares	df	mean Squares	F	*Sig.*	H_0
Between groups	.822	2	.411	.195	.823	Accept
Inter groups	183.233	87	2.106			
Total	184.056	89				

table 4. path analysis pretest creative thinking

Seen from result of above, the significant value gained 0.823 greater than 0.05. Means creative thinking pretest results for the third class there was no difference. To determine the difference in creative thinking of students in the third class derived from the analysis post-test scores. The results of the analysis are shown in Table 5 below:

Sources existence of differences	Number of Squares	Df	mean Squares	F	*Sig.*	H_0
Between groups	98.467	2	49.233	35.128	.000	Not accepted
Inter groups	121.933	87	1.402			
Total	220.400	89				

table 5. path analysis post-test creative thinking

Seen from result of above, the significant value gained 0.000 less than 0.05. Means creative thinking posttest results for the third class there is a difference, it is necessary to further tests to look at the differences in learning PBL, inquiry and conventional.

Class		Mean difference	Sig.	H_0
PBL	Inquiri	-1.833*	.000	Not accepted
	Konvensional	.633*	.041	Not accepted
Inquiri	PBL	1.833*	.000	Not accepted
	Konvensional	2.467*	.000	Not accepted
Konvensional	PBL	-.633*	.041	Not accepted
	Inquiri	-2.467*	.000	Not accepted

table 6. test scores lsd post test creative thinking

From Table 6, the results of post hoc test to post-test creative thinking on PBL, inquiri and conventional. If sig is smaller than 0.05 means that there are differences. PBL models with inquiry the values obtained sig 0.000, between PBL models with conventional obtained sig 0.041, between inquiry models with conventional obtained 0.000. So from the third class all have differences.

IV. DISCUSSION

From the analysis of further tests can be seen that the average ratio of PBL class with the inquiry more effective amounted to 0.833, PBL with conventional learning more effective amounted to 2.067 and conventional learning with models inquiri more effectively amounted to 1.233. So we can conclude that for the development of more effective mastery of concepts done using PBL because a value greater effectiveness than other learning models. Mastery of concepts of biology students in the class experiment better than the control class for environmental management material. From the research, there are significant differences between the three class of learning. Where the class-based problem their mean value is greater than the other class. based on the average value of this class are listed first PBL success rate with the largest average (16.73), the second order for the class of Inquiry (15.90) and the final sequence to conventional class (14.67). Having regard to the average value, then mastery of concepts in PBL class better than the class of inquiry, it is presumably because in the learning process of students are directly involved in learning, concept or theory of seeking support, conduct trials to draw conclusions. Besides the problems that the teacher has been designed according to indicators of mastery of concepts of biology and in accordance with problem-based learning, in addition students are also given the opportunity to display their answers in class discussions and other groups provide feedback on the answers to the problems.

It is this process which enables students to master the concept of learning well. This is in accordance with the opinion of Rusman (2011), stated that the in the model PBM, students can foster problem-solving skills, where students act as problem solvers and learning built thinking, teamwork, communication and exchanging information so as to achieve the purpose of learning diharaapkan. Also according to Abbas (2000), problem-based learning as an approach that prioritizes learning process can be used to train and develop the skills and abilities of science high levels, and improving learning achievement, in a problem-based learning students are required to solve problem independently or guided and also discuss with other students. Mastery of concepts of biology students in the experimental class is better than the control class. It is also consistent with the results of research Suryadi (2011), that the problem-based learning real impact on mastery of concepts so that student learning outcomes any better. In addition, according Susanti (2012), in his research on the influence of problem-based learning and the mastery of the concept of guided inquiry shows that there is significant influence application of problem-based learning, guided inquiry learning and conventional learning to mastery of concepts of biology.

In the ANOVA test path students' ability to think creatively is found there were differences. From the analysis of further tests can be seen that the average comparisons PBL with conventional class learning more effective amounting to 0633, the inquiry with PBL learning more effective amounting to 1833 and with conventional learning models inquiri more effectively amounting to 2,467. So we can conclude that for the development of creative thinking is more effectively done by using the inquiry learning because the value of the ore effectiveness of the learning model to another. Creative thinking abilities of students in biology class experiment better than the control class for environmental management materials. Based on the analysis that has been done, found that both the experimental class has an average value that is better than the conventional class. Where the inquiry learning classes with a higher average value (17.3) in enhancing the creative thinking of students, the second order for the class PBL (15.47) and the final sequence to conventional class (14.83). It is anticipated by the inquiry learning process where students from early learning has been involved directly participate actively thinking in learning where students follow the stages of learning the teacher.

It is this process that requires the student to think of new things, so as to make the students think creatively. In addition, students be motivated in discussion groups, create a sense of mutual respect and eager to solve the problem, the inquiry learning students are required for mutual tolerance and active in solving problems set by the teacher and more active force in delivering the results of discussions. This is in accordance with the opinion of Amier (2010), stated that the the inquiry learning students are not only required to master the subject matter, but how they can use another potential it has. Man who just learned the lesson is not necessarily able to develop the ability to think optimally. Instead, students will be able to develop the capacity to think when he can master the subject matter. In addition Sanjaya (2011), stated that the all activities undertaken students are directed to seek and find the answers themselves from something that is questionable, which is expected to cultivate an attitude of self belief and purpose of its use is to develop the ability to think in a systematic, logical and creative, or develop intellectual abilities as part of the mental process.

Inquiry learning also affects the creative thinking of students, seen from the difference in their mean when compared to conventional learning, it is consistent with research Arnyana (2006), research shows students who learn the strategies Kooperarif GI, PBL, and inquiry, has the ability to think creatively more compared with a group of students who are taught by DI models. According Sukmadinata (2004), creative thinking is a habit of thinking that is dug, turn on the imagination, intuition, cultivate the potential of new, open views that cause admiration, stimulate thoughts unpredictable. While Munandar (2004), defines the creative thinking is based on the ability of the data or information provided find many possible solutions to a problem where the emphasis is on quantity, efficiency and diversity of answers. The more possible answers that can be given to a problem the more creative a person. In other words, many answers can not be given solely to determine a person is creative or not, but also be seen from the quality and the quality of the answer. Aryana (2006), stated that the creative thinking is the use of basic thinking processes to develop or find an idea or the results of the original, aesthetic, constructive associated with the view, the concept, the emphasis is on aspects of thinking intuitive and rational, especially in using information and materials for show or explain to the original perspective thinker.

V. CONCLUSION

In learning innovation as a solution to help the problems in learning in which the student-centered learning is through problem-based learning and inquiry-based learning. This effort is expected to optimize the achievement of creative thinking and improve students' mastery of concepts. The results show that there were significant differences in the application of problem-based learning, inquiry learning and conventional learning to mastery of concepts of biology on the topic of environment at SMPN 23 Seluma. Problem-based learning model is better than learning model Inquiry with the average ratio amounted to 0.833, on mastery of concepts. Inquiry learning model is better than the conventional learning model with the average ratio amounted to 1.833 on the student's ability to think creatively.

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BE-02

CRITICAL THINKING SKILL And Its CORRELATION WITH STUDENT ACHIEVEMENT INDEX CUMULATIVE

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***Abstract*:** This study aims to know is there any correlation between the critical thinking skills of students with a cumulative achievement index gained. Research conducted on students of biology education class in 2014, as many as 55 people. Instruments to measure critical thinking skills such as essay questions with the topic of cell biology. Critical thinking skills obtained in this study is the average of the three aspects, namely the interpretation, analysis, and explanation. Student cumulative achievement index is obtained from the documentation in education courses in Biology. The data were then analyzed with Pearson correlation. Results of data analysis obtained 0,800 significance values greater than 0.05 α value. This means that there is no significant correlation between cumulative achievement index gained student of biology education class in 2014 with the critical thinking skils

Key word: Critical thinking, cumulative achievement index, correlation, evaluation, critical thinking aspects

I. INTRODUCTION

Thinking skills are the skills that are needed in every person's life and even the ability to think is what can determine one's success. Zubaidah (2010), states that a person's success in life is determined by, among others, thinking skills, especially in efforts to solve the life problems that it faces. One of the skills of thinking, is critical thinking. Critical thinking belongs to the higher-level thinking. Critical thinking is an evaluative thinking, evaluation results can be either acceptance or rejection of a information. As stated Fieldman (2002), that critical thinking includes measures to evaluate the situation, problems, arguments, and choose the pattern of investigations that produce the best possible answer. It is also stated by kurfiss (Inch 2006) that critical thinking is an assessment whose purpose is to assess a situation, phenomenon, questions, or concerns to get a hypothesis or conclusion that integrates all the information available so it can be justified with confidence.

Critical thinking is a complex process, and if done properly will help in assessing the complex ideas systematically, so that the problem is easier to solve. According Liliasari (2009) and Johson (2007), that the critical thinking skills using basic thinking analyze the arguments and bring insight to each interpretation, to develop a pattern of reasoning that is cohesive and coherent, the ability to understand the assumptions, formulating a problem, do deduction and induction, as well as taking the right decision. Thus the critical thinking skills are skills that are cognitive fairly high.

The ability to think can not be changed in a short time, but should be continuously and carefully planned (Zubaidah, 2008). The ability to think can be enhanced with a variety of strategies or methods of learning. But in reality, at various levels of education in Indonesia, the learning has not become a means to develop the critical thinking skills of students so that the students' critical thinking skills are low. As stated by Ewie (2010); Hashim (2010) that the other factors that lead to low quality of science education is the lack of development of critical thinking skills in elementary school through college. The same thing also expressed by Rusyana et al. (2011), that in Indonesia critical thinking skills have not been developed to improve the quality of science education.

Critical thinking skills of students can not be separated from metacognitive skills, because the metacognitive skills is a basic component of critical thinking (Weissinger, 2004).

Metacognitive plays an important role in determining the success of student learning, because the metacognitive allows a person to manage cognitive skills, and be able to know the progress and shortcomings so as to determine the cognitive strategies that will be taken. Students who are aware of metacognitive, in other words to have a good critical thinking skills, then learn well and effectively so that it will help to plan and control the learning results. As stated Zubaidah (2008), that the lack of motivation and the critical thinking skills students will result in low learning outcomes. Susantini et al. (2008), also stated that through metacognition students to become independent learners, foster honest attitude, dare to admit mistakes, and can improve learning outcomes. The results of the study Lestari et al. (2013), that increase students' critical thinking skills indirectly followed by the learning outcomes.
Based on the above, This study aims to know is there any correlation between the critical thinking skills of students of biology education University of PGRI Ronggolawe Tuban, with their cmulative achievement index (CAI).

II. REASERCH METHODE

This study is correlational study, to determine the relationship between the critical thinking skills of students with a their cumulative achievement index (CAI) that who are they have acquired. The population in this study were all student of Biology Education Departement, University of PGRI Ronggolawe Tuban. While the sample was student class of 2014, with the number of student 55 people. Instruments to measure students' critical thinking skills is an essay test on the subject of cell biology. Critical thinking skills measured in this study is the average of the three aspects of critical thinking is observed, namely, the analysis, interpretation, and explanation. CAI in this study is a performance index derived from the values for two semesters. This data was obtained from documentation in Biology Education Departement. To determine the correlation between these two variables, the data were analyzed by Pearson correlation

III. RESULT AND DISCUSSION

Data on students' critical thinking skills, can be seen in Table 1.

Table 1. Scores Critical Thinking Skills of Students

No	Score	category	Amount (%)
1	0 – 40	Very less	41
2	41 – 54	Less	29
3	55 – 65	Enough	21
4	66 – 83	Good	9
5	84 – 100	Very good	0

From Table 1, it can be seen that 40% of the students have the critical thinking skills to the category of very less, 29% less, 21% enough category, only 9% have good category, and no student has the critical thinking skills with very good category.

Data on cumulative achievment index (CAI) can be seen in Table 2.

Table 2. Cumulative Achievement Index (CAI) of Students

	CAI $\geq$ 3.00	CAI $\leq$ 3.00
Amount (%)	89.09	10.91

From Table 2, it can be seen that the majority of students had a CIA $\geq$ 3.00, while students who have a CAI of $\leq$ 3.00 is at a very small portion, ie 10.91%. Average Critical thinking skills of students can be seen in Table 3. From the table it can be seen that the average students' critical thinking skills that are in the category of less with the average score was 50.55.

Table 3. Average Score of Critical Thinking Skills and Cumulative Achievement Index (CIA)

	Mean	Std. Deviation	N

Average score of critical thinking	50.5487	9.86268	55
CIA	3.2940	.27253	55

From Table 3, it can be seen that the average score of students' critical thinking skills was 50.54, with less critical categories. While the average CAI of students is 3.23.

The results of data analysis on the correlation between the critical thinking skills of students with a cumulative achievement index can be seen in Table 4. The results of data analysis using Pearson correlation, obtained significance value of 0.800 where the value is greater than the value α of 0.05 (Table 2). This means there is no correlation between the critical thinking skills of students with CAI they earn.

Table 4. Results of Data Analysis on the Correlation Between Critical Thinking Skills and Student Cumulative Achievement Index with Pearson Correlation

Correlations

		Average score of critical thikning	CIA
Critical thinking	Pearson Correlation	1	.035
	Sig. (2-tailed)		.800
	Sum of Squares and Cross-products	5252.714	5.070
	Covariance	97.272	.094
	N	55	55
	N	55	55

There are several possibilities, which caused no correlation between critical thinking skills with the CAI Firstly, that the final value is obtained by the students is the accumulated value of many components, these are the daily tasks, presentation, value midterms, final exams, in equal portions. In other words that the assessment made in the form of authentic assessment. Authentic assessment is a comprehensive assessment conducted to assess the start of the input (input), process (proces), and output (output) learning (Rehusisma & Indriwati, 2014). According Mulyasa (2013), that authentic assessment on the curriculum in 2013, which focuses on knowledge through capability-based assessment be output through the assessment process, portfolio and thorough assessment intact output.

Djulia (2012), states that authentic assessments are necessary to achieve student competence in plenary, which includes personal competence, social, pedagogical, and professional competence.

The application of authentic assessment means to record and appreciate all the activities done by the students during the learning process. It is as stated Corebima (2004), that some of the characteristics of authentic assessment are: 1) It is an integral part of learning in the classroom, 2) use a lot of size, methods, criteria, and 3) is comprehensive and holistic. The importance of evaluating alternatives to traditional evaluation (midterm and final exams), also expressed by Hill (1994), that if the main purpose of learning to create liveliness, independence, and regard learning as a process of lifelong, then the evaluation for traditional as well as the test results learning alone is not enough as an evaluation tool.

Daily tasks and presentation which is one component in determining the student's final grades are generally in the form of the task group, while critical thinking skills are measured individually. In the group tasks, assessment consists of group values and individual values. In the group values all members have the same value, while the value of the individual is a value obtained personally. With the value of the group allows students who have low values be helped so that the final value for the better. Nurhadi, et al. (2004) states that the cooperative learning consciously creating mutually beneficial interaction between the students of the other students. Learning resources for students not just teachers and textbooks but also fellow students.

Another thing that might be cause there is no correlation between critical thinking skills with CIA of students is the questions given to students, both about the midterm and final exams are less demanding advanced thinking abilities such as analysis, synthesis, and evaluation. As stated Lewis and Smith (1993), that critical thinking is a part of high-level thinking. Higher-level thinking that we associate with Bloom cognitive included into C4 (analysis), C5 (synthesis) and C6 (evaluation). According Inch (2006) Critical thinking is a process whereby a person tries to answer rational questions can not be answered easily and where all relevant information is not available. Because of the problems given to students less challenging and explore the potential of higher thought, then all students who have the ability to think better and are less, able to work on such questions. Thus they both scored equally well.

Another factor, which may be because the lack of correlation between the critical thinking skills of students with grade point average is an approach to assessments by the lecturer. In general, lecturers give an assessment using the approach of the norm referenced evaluation, not approach criterion referenced evaluation, so scoring becomes more flexible. On the norm referenced evaluation scores obtained by students compared to scores obtained classmates, while the criterion referenced evaluation approach, the score is compared with the criteria established by the lecturer. When the assessment as a basis for determining graduation or final grades of students, then in a classroom that has an average of less critical thinking skills or academic ability is low, the percentage of students passing will be very small. So the criterion referenced evaluation approach would be difficult to implement. In this research, critical thinking skills of the students were in the category of very less and less to the total number for both is 70% (Table 1), while the average critical thinking skills of the students were in the category of less (Table 3). According to Arifin (2009), that criterion referenced evaluation approach suitable for use in the evaluation that serves to improve the learning process.

In addition, other factors can also cause no correlation between critical thinking skills with a cumulative achievement index (CIA) obtained student is the critical thinking skills of the students themselves.Table 1 shows that the critical thinking skills of students is less varied, 70% are in the category of less and very less, 21% of which are in enough categories, and only about 9%, which is a good category.

IV. CONCUSLION

The results of this study concludes that there is no correlation between critical thinking skills with a Cumulative Achievement index of a student of biology education, University of PGRI Ronggolawe Tuban class of 2014.

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BE –03

Analysis of Learning Outcomes of Biology Based Reflective and Impulsive Cognitive Styles

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Abstract— One's learning style, influenced by differences in how to process and treat the activities that psychology called cognitive style. Cognitive styles according to tempo conceptual can be divided into reflective and impulsive cognitive styles. Based on this do study aimed to determine differences learning outcomes of biology based on reflective and impulsive cognitive styles in students of biology education University PGRI Ronggolawe Tuban class of 2011. To see learning outcomes of biology are obtained based on the value in the subject of plant morphology, plant anatomy, basic genetics, plant development, and molecular genetics. To measure the reflective and impulsive cognitive styles, the study used a MFFT (Matching Familiar Figure Test) instrument which was designed and developed by Warli (2010). The results of measurements of cognitive style on 33 students each were obtained 11 students reflective and impulsive cognitive style or amounts to 66.6%. To examine the differences in learning outcomes of biology student who have a reflective and impulsive cognitive style were analyzed by two-factor Anova using IBM SPSS Statistics 19 program.The results showed that learning outcomes of biology students who have a impulsive cognitive style is better than students who have a reflective cognitive style.

Keywords: *biology, cognitive style, impulsive, lerning outcomes, reflective.*

I. INTRODUCTION

Learning is the process of student interaction with the lecturers and learning resources in a learning environment. Implementation of the learning process takes place in the form of interaction between lecturer, students, and learning resources in a particular learning environment [1]. The learning process is a conscious activity between lecturer and students that aims to produce a change in behavior of students in terms of knowledge, skills, and attitudes. In general, changes in student behavior after learning activities demonstrated through learning outcomes. Learning outcomes can describe the capabilities of a person after experiencing a learning process. Learning outcome is also proof of the success already achieved someone or maximum result is achieved someone after making efforts to learn [11].

Learning outcomes of each individual will be different from each other, but the learning process is given to learners are the same. This is because that each individual has specific characteristics, which are not owned by other individuals. Therefore it can be said that every individual is different from one another. This difference is of course caused by many factors. According [8]. that the learning outcomes are influenced by internal factors are derived from the individual's own and external factors that come from the environment. One of the internal factors that influence the outcome of one's learning is learning style. [12] describes the aspects related to the personality of students, one of which cognitive function. Cognitive function related to student learning outcomes of cognitive aspects include: the level of intelligence, creativity, special talents, cognitive organization, level of proficiency, the power of fantasy, learning styles (cognitive styles, types of learning, thinking styles, techniques and methods), One of the characteristics of students who need to be understood by an educator in the achievement of learning outcomes are the differences in learning styles of learners.The difference in the person's learning style resulting in the ability to understand and absorb the lessons would be different.

[10] explains that learning style is the way learners about how to use / exploit information. Using information as an approach for students in understanding the lesson material with logic, systematic way or approach for learners with learning to understand, use, and learn to memorize. A person's learning style is influenced by cognitive style, namely a distinctive way to a person in learning whether related the

acceptance and processing of information, attitudes toward information, nor the habits related to the learning environment. According [8] each individual besides different at the level of problem-solving skills, level of intelligence, or the ability to think, may also differ in the way of acquiring, storing and applying knowledge. They can be differ in approach to learning situations, in the way they receive, organize and connect their experiences, in the way they respond to certain teaching methods. Differences between personal settling into ways of arranging and processing information and experiences known as cognitive style.

Cognitive style is an important factor that must be considered by the lecturers in the learning process. According to [1] if the student styles in learning are accommodated, that it can be improve the attitude of learning, thinking skills, academic achievement, and creativity. Cognitive style is a characteristic that tends to remain on a person in terms of feel, remember, organize, process, think, and solve problems to [4] and [2]. While [3] explains that cognitive style is individual variation in terms of feel, remembering, thinking, or as a way to distinguish, understand, save, embody, and use information. Cognitive style of many kinds, one of which cognitive style was found by Jerome Kagan in 1965, covers an reflective cognitive style and impulsive. Someone who has the characteristics of quick in answering the problem, but lacking / not carefully controlled so that the answers tend to be wrong, This it can say that a person is impulsive cognitive style. While someone with a slow in answering the problem, but carefully and thoroughly so that the answers tend to be true, that it can be said that the person's reflective cognitive style [10].

Cognitive style could have a positive or negative relationship with motivation, academic achievement depends on the nature of the learning task. Cognitive style has the following characteristics: 1) put more attention on the shape of the contents of cognitive activity. This refers to individual differences in terms of, feel, have, solve problems, and connect with other people; 2) cognitive style is a dimension to penetrate; 3) cognitive style is fixed, does not mean it can not change; 4) taking into account the value, cognitive style is bipolar [9].

Biology as a branch of Natural Science which focus the discussion on biological problems through the process and scientific attitude. As a branch of science, then in biology learning is learning-oriented nature of science that includes products, processes, and scientific attitudes through the process skill [7]. Subjects plant morphology, plant anatomy, plant develoment, basic genetics, and molecular genetics, including in the biological sciences. Learning from the fifth subjects has not just memorize facts, principles, and theories, but also emphasized the process to build student knowledge. In the sense that the five learning courses has been adapted to the demands of the learning process standardization in college. Forms of learning are usually lecture and practicum. The learning method used in the implementation of learning during this time are usually focus group discussions, cooperative learning, group presentations, and administration tasks. The success of the student in the learning process in the subjects of plant morphology, plant anatomy, plant development, basic genetics, and molecular genetics can be seen from learning outcomes obtained.

Referring to the background of the problems outlined in the introduction above, then the problem can be formulated as follows: 1) is there a difference in learning outcomes of biology, between students who have reflective and impulsive cognitive style?; 2) is there any difference in learning outcomes in the subjects of plant morphology, plant anatomy, plant growth, basic genetics, and molecular genetics between students have reflective and impulsive cognitive style ?; 3) is there any interaction between the learning outcomes of biology and reflective and impulsive cognitive style?

The purposes of this study are to obtain accurate information on: 1) the learning outcomes of biology between students who have reflective and impulsive cognitive style; 2) the learning outcomes of subjects on plant morphology, plant anatomy, plant growth, basic genetics, and molecular genetics between students have reflective and impulsive cognitive style; 3) The interaction between the learning outcomes of biology with reflective and impulsive cognitive style?

The benefits of this research is to increase knowledge in designing the learning model that accommodates differences in cognitive styles of students, especially reflective and impulsive cognitive style.

II. METHODS OF RESEARCH

The types of research that is used, namely a comparative study with the aim to see the differences in learning outcomes of biology, on students who have reflective and impulsive cognitive style. Data learning outcomes of biology are obtained through technique of documentation in the form of test scores for each subject, namely plant morphology, plant anatomy, plant development, basic genetics, and molecular genetics. The technique of documentation is done, because the implementation of the test for each subject, namely plant morphology, plant anatomy, plant development, basic genetics, and molecular genetics in different semesters. While for collecting of data cognitive style was performed with using technique of test. The instrument is used to measure cognitive style, namely MFFT (Maching Familiar Figures Test) which was designed and developed by [10]. MFFT instrument includes one standard image and 8 variation images. Through this instrument the student is assigned to select one from eight images the same variation with a standard image. The variables were observed, namely time required by students to answer the first time and the frequency of students answered to produce the correct answer.

Research was conducted on student class of 2011 totaling 33 people. Implementation of the research to measure cognitive styles performed at the time of the semester 3. As for the steps to measure cognitive style includes: 1) calling students one by one to completed Test cognitive style through an instrument MFFT by seeking a variation images corresponding to the standard image; 2) record the time used by the student to answer the first question; 3) records the number of answer to obtain correct answers; 4) calculate the amount of time and fekwensi error then divided by the number of items to obtain the average; 5) looking for a median of time (t) and the frequency of (f) and then drawn a line parallel to the axis t and f axis, so that will form four groups of students.

According [10] the four student groups include: 1) a group of students who have characteristics in answering the problem quickly and carefully / thoroughly so the answer are always right; 2) a group of students who have the characteristic slow in answering the problem and carefully / meticulously so that answers are always right (reflective student); 3) a group of students who have characteristics quick in answering but less accurate / less precise that the answers are often wrong (impulsive student); 4) The student group that has the characteristics of slow in answering the problem and less accurate / less precise that the answers are often wrong. In this study is limited to the student reflective and impulsive student only. Furthermore, the data that have been collected will be analyzed using two kinds of statistical techniques, namely descriptive statistics and inferential statistics. Descriptive statistics were used to describe the characteristics of the learning outcomes on subject plant morphology, plant anatomy, plant growth, basic genetics, and molecular genetics based reflective cognitive style reflective and impulsive. For the purposes of the median. For inferential statistics using the two-factor ANAVA. Calculations were performed using IBM SPSS Statistics 19 program.

III. RESULTS AND DISCUSSION

A. Result

Measurement of cognitive style using instruments MFFT (Matching Familiar Figures Test) with the observed variables consists of the time required by students to answer the first time and the frequency of students answered to produce the correct answer. Cognitive style is measured at the time the student class of 2011 in semester 3. The author does not do re-measurement of cognitive style, because in theory a person's cognitive style tends to remain. Besides cognitive styles have been used for some research either already published or in the process of publication, such as 1) the critical thinking skills of students who have impulsive and reflective cognitive style in the subjects of basic genetics [14]; 2) a comparison of the ability of students that reflective and impulsive cognitive styles in writing a scientific article as the result of case studies on environmental issues (in the process of being published). The summary of the results of measurements of cognitive style can be seen in Table 1.

Tabel 1. The Summary of the Results of Measurements of Cognitive Style

Class of	Number of Sudent	Time			Frequency			Number of Students Impulsive	Number of Students reflective
		Max	Min	Med	Max	Min	Med		
2011 A	33	73,18	5,68	14,7	4,23	1,62	2.69	11	11

Information: Max: The Maximum Data Med : Median
Min: The Minimun Data

The results of data analysis using two- factor ANOVA test, to determine the difference in learning outcomes of Biologi between students who have reflective and impulsive cognitive style can be seen in Tabel 2 and 3.

Tabel 2. Descriptive Statistics

Dependent Variable:value

Subject	Cognitive Style	Mean	Std. Deviation	N
Plant Morphology	Reflective	3.3182	.56003	11
	Impulsive	3.6818	.60302	11
	Total	3.5000	.59761	22
Plant Anatomy	Reflective	3.2727	.46710	11
	Impulsive	3.6818	.40452	11
	Total	3.4773	.47503	22
Basic Genetics	Reflective	2.4091	.94388	11
	Impulsive	2.9091	.91701	11
	Total	2.6591	.94348	22
Plant Development	Reflective	2.8636	.63604	11
	Impulsive	3.0909	.37538	11
	Total	2.9773	.52275	22
Molecular Genetic	Reflective	2.6818	.60302	11
	Impulsive	2.9545	.47194	11
	Total	2.8182	.54654	22
Total	Reflective	2.9091	.72706	55
	Impulsive	3.2636	.66566	55
	Total	3.0864	.71632	110

Tabel 3. Tests of Between Subjects Effects

Dependent Variabel:Value

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncen Parameter	Observed Power[a]
Intercept	Hypothesis	1047.820	1	1047.820	303.117	.037	.997	303.117	.828
	Error	3.457	1	3.457[b]					
Subject	Hypothesis	12.986	4	3.247	50.123	.001	.980	200.491	1.000
	Error	.259	4	.065[c]					
Cognitive Style	Hypothesis	3.457	1	3.457	53.368	.002	.930	53.368	.999
	Error	.259	4	.065[c]					
Subject * Cognitive Style	Hypothesis	.259	4	.065	.165	.956	.007	.660	.084
	Error	39.227	100	.392[d]					

a. Computed using alpha = .05
b. MS(cognitive Style)
c. MS(Subject* Cognitive Style)
d. MS(Error)

B. Discussion

1. The Measurement Results at the Cognitive Style

Measurement of cognitive style requires two observed variables, namely time and frequency. The time indicate duration the student to answer the first time. Frequency answer indicate number of students answered until a correct answer. Based on Table 1 the maximum time it takes a student is 73, 18 seconds and the minimum time is 5.68 seconds. While the maximum frequency answered was 4.23 and the minimum frequency was 1.62. Limits to classify students as reflective and impulsive, using the median of the time and frequency answer. The results obtained from grouping students who have reflective cognitive style total of 11 people (33.3%) and students who have impulsive cognitive style total of 11 people (33.3%). This indicate that the proportion of students who have reflective and impulsive cognitive style of more than 50%, namely 66,6%. While the rest of 33.4% is the number of students that have the characteristics of fast and precise / accurate in answer or slower and less precise / less accurate in answer. So the sample met the criteria of reflective cognitive style and impulsive total 22 students, with 11 students who have reflective cognitive styles and 11 students who have impulsive cognitive styles. The few studies that have been done proportion of reflective children and impulsive are more than the group of children quickly and carefully and slowly and inaccurate. Research [6] found the proportion of reflective children and impulsive were 76.2%, as well as research that has been done [9] that the proportion of the characteristics of reflective-impulsive were 73.8%. ,

2. Learning Outcomes of Each Subject

Based on Table 3 shows that F count to the learning outcomes for each subject is 50 123 with a probability of 0.001. Because the probability of <0.05, then the leraning outcomes on plant morphology, plant anatomy, plant growth, basic genetics, and molecular genetics indicate a difference. Because there are significant differences then to see the learning outcomes the most good, seen from the total mean for each subject as shown in Table 2. Based on the results of descriptive statistical analysis are presented in Table 2 shows the total mean to subject plant morphology highest value, the second order plant anatomy, then plants development, molecular genetics, and the final sequence is a genetic basis. Results of study on plant morphology showed the most good, this is because that the material of plant morphology included in the factual and conceptual knowledge. Based on the revised Bloom's taxonomy, that is the factual knowledge, the knowledge base must be known to the student so that the student is able to understand a problem or solve the problem.While the definition of conceptual knowledge, namely a basic knowledge which interconnected and with a larger structure so that it can be used together While on the basis of genetics the characteristics of the material is procedural knowledge, namely the knowledge of how to do things, methods to search for something, the knowledge that favor ability, algorithms, techniques, and Methods [13].

3. Learning Outcomes of Biology Between Students have a Reflective and Impulsive Cgnitive Style

Based on Table 3 shows that F count for learning outcomes of biology between students who have a reflective and impulsive cognitive style is 53 368 with a probability of 0.002. Because the probability of <0.05, so there are differences in the learning outcomes of biology between students who have a reflective and impulsive cognitive style. Based on these differences, where between the students who have a reflective and impulsive cognitive style, which better learning outcomes of biology. Based to Table 2 shows that the mean learning outcomes of biology for student who have a impulsive cognitive style was higher than students who have a reflective cognitive style. This is consistent with the theory that the impulsive cognitive styles have a positive relationship with learning outcomes [9], because of the characteristics of the five subjects generally be factual and conceptual. The results of this study are different with studies on the matter of a procedural nature such as in mathematics associated with critical thinking skills, students who have a reflective cognitive style superior to the impulsive [16]. While research of [15] showed no difference in the learning outcomes of mathematics between students who have a reflective and impulsive cognitive style. Furthermore, based on Table 3 shows that, F count for the interaction between the learning outcomes with reflective and impulsive cognitive style are 303 117 with a probability of 0.037. Because the probability of <0.05, so there are an interaction between the learning outcomes with cognitive style (Reflective and impulsive). This means that the learning outcomes to plant morphology, plant anatomy, plant growth, basic genetics, and molecular genetics influenced by cognitive styles of students (reflective and impulsive).

IV. CONCLUSION AND SUGGESTION

Conclusion

Based on the results of the research that have been described, it can be concluded as follows: 1) There are differences in learning outcomes on plant morphology, plant anatomy, plant growth, basic genetics, and molecular genetics. Of the five subjects, the learning outcomes of students are most excellent, namely in plant morphology; 2) There are difference in learning outcomes of biology between students who have reflective with impulsive cognitive style. Students who have impulsive cognitive styles, the learning outcomes of biology are better than the reflective cognitive styles; 3) There are interaction between the learning outcomes of biology and cognitive style (reflective and impulsive cognitive style). This means that the learning outcomes of students in biology affects cognitive style.

Suggestion

Based on the conclusions that have been put forward, it is advisable to research information about reflective and impulsive cognitive styles can be used as consideration, for lecturers in choosing models, approaches and methods suitable for learning.

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BE-04

SERVICE LEARNING IN BIOLOGY CLASS:
Philosophy Foundation, Principles, Benefits, and Implementation

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Abstract - Service learning (SL) is a teaching method that combines classroom learning materials with service activities. The aim of this study to provide a foundation for the development of SL into teaching, especially in biology classroom. This study will explain the philosophy foundation for development of SL, describes the basic principles of SL implementation in teaching, outlining the benefits of SL implementation in teaching, as well as to describe the implementation of SL in biology learning. This study was a metaanalysis study. Data obtained from books and journals in the library or obtained online. From the study known that SL develops from a philosophy foundation of progressivism, experimentalists, and experiential of John Dewey. Development of SL motivated by three things: (1) the lack of relevance of the curriculum with the real world, (2) lack of commitment of teaching staff in the learning process, and (3) lack of a response education institutions (colleges) on community issues. Step-by-step SL in the form of a cycle known as IPARD (Investigation, Planning and Prepare, Action, Reflection, and Demonstration). From the literature study know that SL can improve learning outcomes of cognitive, affective, character, involvement in school, motivation, and the ability to think critically. SL can be developed in biology learning to adjust service activities with learning materials in the classroom.

Keywords: *Service learning, teaching, biology, methods*

I. INTRODUCTION

Service learning is a teaching method that combines formal instruction with community service activities. Service learning is a teaching method in which students are exposed directly to the issues raised in the community. Students are challenged to implement a program that can help overcome the problems that occur in the community armed with the theory that they have acquired during the learning process in class. In its activities, service learning will integrate the activities of public services, the concept of learning and reflection to enrich the learning experience, concern for the community, and encourage community involvement.

Many definitions of SL that has been proposed by the experts. Kezar & Rhoads (2001) defines SL as an "*academic service learning*", as seen in the following quote:

> *"Service learning is a pedagogical model; it is first and foremost a teaching methodology, more than a values model or a leadership development model or a social responsibility model. Second, there is an intentional effort made to utilize the community-based learning on behalf of academic learning, and to utilize academic learning to inform community service. This presupposes that academic service learning will not happen unless concerted effort is made to harvest community-based learning and strategically bridge it with academic learning. Third, there is an integration of the two kinds of learn- ing-experiential and academic; they work to strengthen one another. And last, the community service experiences must be relevant to the academic course of study".*

Rhodes & Davis (2001) in (Warren, 2012) states that SL is a pedagogical strategy in which students engage in community service that will enhance their understanding of the learning concept and enable them to make a contribution to society. G19iles (2011) in Karmasyah, *et al*., (2013) explains that SL is a learning model that combines classroom learning with public service activities, and the learning process is reinforced by their reflection.

In practice, SL can be categorized as a form of experiential learning where students are involved in activities that aimed at the needs of people and society (Jacoby, 2015). In its activities, SL will integrate the activities of public services, the learning concept and reflection to enrich their learning experience, concern for the community, and encourage community involvement. *The Community Service Act* of 1990 provides a definition of SL as follows:

> *"A method where students or participants can learn and develop through active participation in an organized service activities is carried out based on the problems encountered in the community; in practice occurred coordination between primary schools, secondary schools, higher education institutions, or public service programs with the communities to be served; integrated into the academic curriculum or educational component as well as providing time for students or participants to reflect on the experience of service to the community ".*

Keeton (1983) in Lunar (2012) states that SL activity is rooted in the theory of constructivism, which connects the students with the experience of reflection and analysis in a learning curriculum. Thus, the learning experience aligned to be able to change the learners, helping them revise and increase knowledge and change their practices. It can affect the aesthetic and ethical commitment of individuals and alter their perceptions and interpretations of the world. Some definitions clearly states that SL must be part of the academic curriculum (Jacoby, 2015).

Andrew Furco (1996) in Jacoby (2015) provide a model that describes the uniqueness of SL that distinguishes it from other forms of *community-based work* and experiential learning, as seen in Fig. 1.

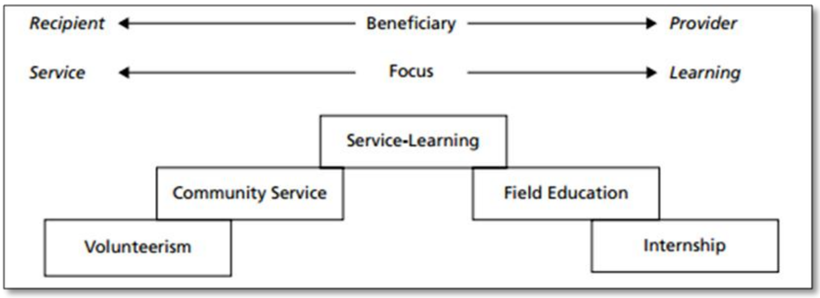

FIGURE 1.Difference In Service Program (Furco, 1996 in Jacoby, 2015)

Volunteerism and *community service* is on the left side, which is focused on and intended for the benefit of individuals, organizations, or the community being served. Volunteerism is at the base, a form of charity. Volunteerism associated with providing the services, with no connection between reflection and learning. Up to the next level, "community service" in which students engage in activities designed to meet the needs of human and society. The program is more structured and more sustainable than in volunteerism, thus providing greater benefits to service recipients. Community service does not necessarily include reflection and may be weak in terms of academic credibility. On the right side there are *internship* and *field education*, which is intended for students with the main goal is the learning process. Internship is an experience in which the students involved to learn more about their field and to gain practical experience in the field of employment potential. Internships can be associated or not associated with learning material, it could be involved or not involved reflection. Field education, generally related to the curriculum. The focus of the field education is to improve student learning in the field they studied. Reflection can be part of the experience. Internships and field education targeted at the needs of man and society, but students do not do it voluntarily. At the center of the model, SL trying to strike a balance between student’s learning process by providing benefits to the community. One basic principle is "Service, combined with learning, adds value to each and transform both" (Porter-Honnet & Poulsen, 1990). SL is based on the assumption that learning is not always the result of experience, but also reflects the results of which are designed to obtain a specific learning outcomes. In this case, expanding on the concept of SL and community service volunteerism (Furco, 1996) in (Jacoby, 2015).

Implementation of service learning can develope student’s cognitive and affective aspect or character. Until now, the process of learning in biology education largely apply the learning in the classroom and laboratorium. Not many subjects that apply learning outside the classroom. Not many teachers who provide direct experience for students to go into the community to apply the knowledge they have acquired in class. With such activities students can explore his abilities as well as to develop their personality and character. Service learning has been widely applied in teaching, especially in American's college. In Indonesia, this method was rarely used. This method is feasible to be developed in Indonesia because of the advantage were great especially for developing the character. For developing SL as a learning method, we have to understand the background of development SL, the phylosophy foundation, how the process, and learn the implemantation of SL at biology subject. With this study we will find the right design for implementing SL in learning process, especially learning biology, in Indonesia.

The aims of this study was formulated as follows:

a. To explain the development background of SL
b. To describe the basic principles of implementation SL
c. To describe the benefits of the implementation SL in the learning process
d. To describe the implementation of SL in biology class

II. METHODOLOGY

This research was a metaanalysis study which analyse the aspect of service learning as background developments , basic principles of implementation, the benefits of implementation, and how implementation of SL in biology class. The source of this metaanalysis study was collect from 10 article and 2 books and analyse with description from the source.

III. RESULT AND DISCUSSION

A. Background of Service Learning Development

Development and interest in SL is a response to three criticisms of the college, (1) lack of relevance of the curriculum with the real world, (2) lack of commitment from educators in the learning process, and (3) lack of a response from education institutions at community issues (Kezar & Rhoads, 2001). Experties at philosophy of education argue that the main purpose of education, higher education in particular, is to produce citizens who are ready to serve the community. John Locke (1997) and Immanuel Kant (1997) also issued an opinion regarding character education. Expert on philosophy education agree that education should not only on scientific facts and theories, but also contained learning about the principles of moral and character development and implementation (Speck & Hoppe, 2004).

In the late 1960s and early 1970s there was a wave of changes in higher education. Many pedagogical innovations that developed in this period, including multikulturalism, collaborative learning, learning communities, and SL. This pedagogical innovation evolved from the philosophy of education based on experiential learning approaches and emancipatory (Kezar & Rhoads, 2001).

> *"Students need to see the connection between what they learn with how their lives. Specifically, we recommend that each student completing a service project to the community, such as doing voluntary work in a community or in college ... The goal is to help students see that he is a member of the community in which they also have a responsibility" (Boyer ,1987 in Kezar & Rhoads, 2001)*

The growth of organizations like Campus Compact and Campus Outreach Opportunity League (COOL) in the late 1980s was a part of a response to the irrelevant curriculum and students as well as leaders of institutions to generate meaningful experience. Criticism during the 1980s and 1990s about the changing role of schools (colleges) also contributed to the emergence of SL. A number of academics and policy experts have seen a growing trend for more teachers or lecturers to start focusing on the research and publications in addition to its main activities, teaching. Not faculty who spend a lot of time to teach that obtain a larger salary (Boyer, 1987, 1990) in (Kezar & Rhoads, 2001). SL is a pedagogical strategy that is regarded by the academic community as a strategy that offers innovative and fresh air for the learning process (Howard, 1998; Stanton, 1994; Zlotkowski, 1998) in (Kezar & Rhoads, 2001). As an innovative pedagogical strategies, SL can link between teaching and research.

The emergence of SL is also related to the criticism that the university, in general, and faculty, in particular, are less responsive to the problems of society (Bok, 1982; Ehrlich, 1995; Hackney, 1994). Works of literature that emerged in the 1980s and continued until the 1990s showed significant attention to the modern conception of society and often education target as a source of problems as well as giving a solution (Barber, 1992; Battistoni, 1985, Bellah, Sullivan, Swidler, & Tipton, 1985; Parks Daloz, Keen, Keen, & Daloz Parks, 1996; Rhoads, 1997; Wuthnow, 1995). Linking the process of teaching and learning with the interests of the community through activities such as SL allow institution to be involved in responding to community problems and challenges students to make judgments about their role in society. Campus Compact emergence in the late 1980s was not just an attempt to improve the relevance of the curriculum to the student experience, but also helps to improve the relationship between higher education institutions with society (Kezar & Rhoads, 2001).

Service learning is also known as as experiential learning. The growth of SL many colored by the experiential grounding philosophy of John Dewey, as apparent in the writings of Dewey's "Democracy and Education (1916)", "How We Think (1933)", and "Experience and Education (1938)" (Jacoby, 2015). Dewey is a progressive education leaders who developed the theory of pragmatic or instrumentalist or experimentalists as the root of SL (Speck & Hoppe, 2004). Dewey's educational philosophy develops from the analysis that the history of philosophy is influenced by dualism (practice and knowledge) that prevent the evolution of education for a democratic society. This is evident in Dewey's statement:

> *"The notion that experience consists of a variety of segregated domains, or interests, each having its own interdependent value, material, and method, each checking every other, and each is kept properly bounded by the others, forming a kind of balance of powers in education. On the practical side, they were found to have their cause in the divisions of society into more or less rigidly marked off classes and groups-in other words, in obstruction to full and flexible social interaction and intercourse, . . . resulting in various dualisms such as practical and intellectual activity, labor and leisure, individuality and association". (1916, p. 323)* in Kezar & Rhoads (2001)

Dewey shows that education in a democratic society must evolve beyond the problem of dualism in education, because education methods and processes should be in accordance with the purpose of education. Dewey opposes dualism that separates knowledge with practice. An education system that adheres to dualism, resulting in no involvement of pedagogical techniques, curriculum empty, lack of moral development, a lack of unity, as well as the lack of integration between experience and knowledge (Kezar & Rhoads, 2001).

Dewey argued about philosophy of continuity. This philosophy based on the belief that human beings, as a holistic being, will learn better with the mind, body, spirit, experience and knowledge (Kezar & Rhoads, 2001). Continuity provides the opportunity for students to test the theory and solve problems so that they can respond to situations in the future (Speck & Hoppe, 2004).

Famous opinion of Dewey's "*Education of, by and for experience*". "*Education by experience*" mean that students learn through experience. Through the "education of experience", Dewey expect student's capacity to understand the world will increase. Experience was an active response to a situation (Speck & Hoppe, 2004).

Dewey saw that the experience can be a part of education, as in the following passage (Jacoby, 2015):

> *"The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative. Experience and education cannot be directly equated to each other. For some experiences are mis-educative" (1938, p. 25)*

From the quote above clearly shows that Dewey emphasized an award of experience in the learning process, but not all contain aspects of educational experience. Exposure to an experience should be arranged in such a way so as to provide meaningful learning for students. Students will acquire the meaning of learning from experience through the process of reflective thinking. In the absence of reflection, then the experience will have no meaning. Reflection is a core element of SL (Jacoby, 2015). The capacity of reflection in problem solving is a sign that someone is educated (Speck & Hoppe, 2004).

From the above explanation it appears that SL is one form of progressive education that based on a Dewey's model. SL involves the exposure of social problems to the students, challenging students to provide solutions and applying the ideas that come from learning in the classroom (Speck & Hoppe, 2004). In SL, students will learn about solving the problem. In the process the activity involves the reflection of the experience they get. With all activities, SL can help prepare students to become citizens who are ready to join in communities to provide solutions for existing problems.

B. Basic Principles on Aplication of Service Learning in Education

Rooted in work Dewey, Jean Piaget, and Kurt Lewin, David Kolb's Experiential Learning Model provides the basis for the implementation of SL. The model has four components: (1) concrete experience, (2) observation and reflection on the experience, (3) the establishment and the development of abstract concepts based on reflection, and (4) active experimentation to test the concept in a new situation. These four components are form a learning cycle where students can enter into the cycle of all points. However, in general, the design of SL begins with exposure to the real experience. Learning occurs with the repetition of the cycle, where learners test the new concept that he developed into a real experience and continues with other components (Kolb, 1984) in (Jacoby, 2015). The Principles of Good Practices in Combining Service and Learning, commonly known as "the Wingspread Principles", provides guidance in the development of SL since the 1990s. There are 10 principles in combining learning with service : (Jacoby, 2015)

1. Involve the students in a responsible action and challenging with a view to the common good
2. Provide opportunities (structured) for learners to reflect critically on their service experience
3. Convey clear learning objectives and services performed
4. Allow for reviews those in need to define reviews those needs
5. Clarify the responsibility of any person or organization involved in activities
6. Match the needs of service providers with the needs of the service through a process that recognizes changes in circumstances
7. Active and continuous commitment
8. It involves training, supervision, monitoring, support, recognition, and evaluation in achieving the learning objectives and service
9. Make sure that the learner has to be a flexible and adequate time commitment
10. Having the commitment to participate in the program and together with a diverse population

Youth Service America provides steps in the implementation of SL, known as IPARD (Investigation, Planning and Prepare, Action, Reflection, and Demonstration) (America, 2011). Investigation is an early stage, in which students are required to analyze the problems that exist in society. The second phase is the Planning and Preparation, where students create a plan of action what he would do to solve the existing problems in the community. In this stage, students also prepare all the necessary things for the activities of the action. In the third phase, Action, students carry out planned activities directly to the public beforehand. Phase 4, Reflection, students look back at the experience to take action and learn to conduct an evaluation of the activities already carried out. And the last stage is Demonstrastion, where students shared his convey of their activities and their evaluation (Cahyani, Santosa & Indrowati, 2012).

Fig. 2 below shows the development model of SL experience. This model is repetitive, which allows students to share, reflect, and process their experience and their learning. Teachers can guide students through the questions with open answers, stimulate thinking and feeling. In this stage of generalization and application, teachers can guide students to make the connection between the meaning of the activity in private with the wider world, giving emphasis on the important thing, and answer the question, "Now what?" To record the activity and student reflection, can be helped by using journal. This journal can simultaneously used as one of the evaluation material. Reflection can be guided with questions or free reflection (MacFall & Braun 2007).

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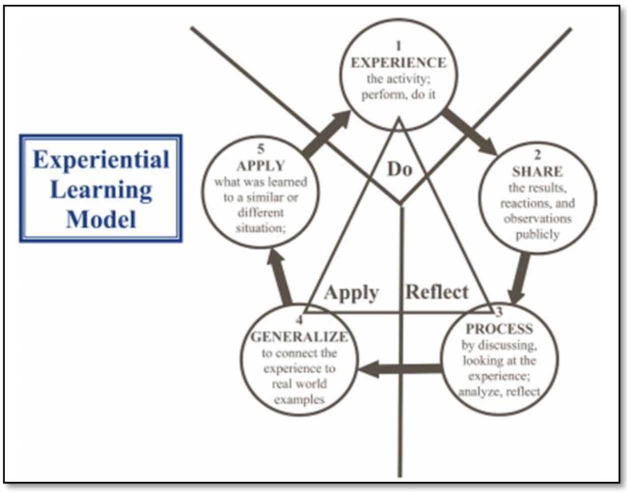

FIGURE 2. Conceptual Model of Service Learning (McFall and Braun, 2007)

Eyler and Giles (1999) states that there are four criteria that states a successful SL activity, (1) the development of personal and interpersonal; (2) understanding and application of knowledge studet get in the classroom; (3) transformation of perspective; and (4) the development of citizenship (Warren, 2012). Numerous studies show the positive influence of the implementation of SL as developmental level thinking, empathy, awareness of cultural, personal and interpersonal development, motivation to get involved in social issues, motivation to learn, social inclusion (Warren, 2012).

C. Benefit of The Aplication of Service Learning on Learning Process

SL continues to grow, but the question arises what exactly the learning outcomes expected from the implementation of SL. Kezar & Rhoads (2001), states that the primary emphasis on SL is the cognitive development of students. Zlotkowski (1995) asserts that the instigators of SL should be able to connect their service activities with academic learning practices. Barber & Battistoni (1993), explicitly linking SL with classroom learning in order formalization of civic education, the main principle, "Educational institutions are learning communities, not service agencies, and... The primary justification for service programs has to be pedagogical "(Kezar & Rhoads, 2001).

Kendrick (1996) made a research about the comparison between students who apply SL and students who do not implement SL in learning sociology, and found that students who apply SL achieve slighly higher score on quiz and essay than students who do not implement SL. The results are in contrast found by Moely, McFarland, Miron, Mercer, and Ilustre (2002), where students who applying SL gain results slightly lower than students who do not implement SL. This is in line with the meta-analysis conducted by Novak et al. (2007) which states that SL has a positive effect on student learning outcomes. In addition, it also has contributed to increasing student’s awareness and social responsibility (Warren, 2012).

Research by Weiler, LaGoy, Crane and Rovner (1998) in Furco & Root (2010) on 775 students at the first and middle level in 12 classes that perform SL and 310 students in the eighth grade who are not doing SL. The results showed that there were significant differences in learning achievement at both groups. In addition, students who implementing SL said that they learned more with SL activities. The results of several studies indicate that SL has a positive impact on student achievement. SL also contributes to the learning outcomes at affective domain of students, such as self-confidence, social responsibility and respect for themselves (Astin & Sax, 1998; Boss, 1994; Eyler & Giles, 1996; Giles & Eyler, 1994; Gray et al. 1996; Kendrick, 1996; Mark, Howard, & King, 1993; Waterman, 1993), developed tolerant behavior of cultural differences (Coles, 1993; Myers Lipton, 1996; Neururer & Rhoads, 1998; Rhoads, 1997, 1998a, 1998b) in (Kezar & Rhoads, 2001), developing the leadership capacity of students (Ladewig and Thomas, 1987; Weiler, et al, 1998; and Boyd, 2001). SL is seen as an approach to education that allows students to think, assess, care, or do something and prepare to face the challenges of the future (Karmansyah, Muljadi, & Saputro, 2013).

SL can improve student engagement in school and learning process. In a quasi-experimental research conducted by Conrad and Hedin (1981) in Furco & Root (2010) to more than 1000 students (aged 12-19 years) show that students which involved in SL have an interest and a higher motivation in learning when compared with students who are not involved in SL. In addition, this study also found that SL provides an opportunity for students to act autonomously, develop collegial relationships with adults and peers, and improve their self-esteem and the ability to organize themselves to do something more effectively. Increased school motivation and positive attitude has also been reported by several other studies. Furco & Root (2010) summarizes a number of studies, for example on research Melchior (1998) that shows that students who carry involvement in SL has a higher learning than students who do not implement SL. Further Rockquemore & Schaffer (2000) also stated the same thing that SL can increase student engagement. If students are engaged, they become more motivated to learn (Flournoy, 2007; Shulman, 1995). As a result, they will learn more, in terms of both cognitive and affective (Frymier, Shulman, and Houser, 1996) in (Warren, 2012).

Research on the application of SL to cultivate an attitude of environmental concern ever undertaken by Bernardo C. Lunar in the research entitled "Creating Environmental Awareness and Sensitivity through Service Learning in Ecology Class". The study involved 35 students who attend ecology class. From these studies know that SL activity is a good way to cultivate an attitude of concern for the environment so that it can affect the attitude of responsibility and active participation of students. Another study conducted by Kastuhandani in 2012. In his paper entitled "Our Dream, Effort, and Reflection: SLP AJCU Participant's Lived experince" mentioned that the SL activity can increase the sense of social awareness within the student. Research by Handoyo in 2014, also showed consistent results. The results of the study entitled "Cultivating Character Students through the Service Learning Program in Subjects of Nutrition and Health", indicates that SL can enhance creative character, responsibility, hard work, communicative and social care of the students.

Research by Eyler and Giles (1999) in MacFall & Braun (2007) also stated the same thing. In his research found the positive correlation between SL with the ability to understand the complexity, application of knowledge, critical thinking, tolerance, personal efficiency, leadership ability, and is open to the new opinions.

From the above explanation, it can be seen that SL has many positive benefits for the development of students, not only a positive effect on the cognitive learning, but also impacts on the development of affection, develop character, improve motivation also develop the ability to think critically.

D. Aplication of Service Learning in Biology Class

Not many studies that illustrate the application of SL as a learning method in biology classroom. Several studies have found is the study of Handoyo (2015) and Nugroho & Sucahyo (2013). Handoyo (2015) conducted a study on 65 students who attended the Nutrition and Health Science class. SLwhich carried out in this course have the aims to develop the character of social care, especially related to food security issues. SL is part of the course of Nutrition and Health Scienceand included in the final assessment component. Students were divided into 12 groups. Activities undertaken by the student is doing outreach to the community related to the issue of food security at household level as increasing knowledge and awareness of food and nutrition, skills to manage the food and the consumption of a balanced diet, sanitation and hygiene in the food sector, and family resources to improve nutrition, and increased awareness of food quality and safety in the community. Topics selected based on the extension of existing problems in the target communities. In addition to providing counseling, student groups also helped posyandu in place of their goals. In doing so, students conducted field observations in advance to see the problems that occur as well as apply for permission to carry out activities. After observation, the students plan what programs will be implemented. The next stage is the implementation of the program, followed by an evaluation and reflection.

Research by Nugroho & Sucahyo (2013) about implementation of SL in the Faculty of Biology, Satya Wacana Christian University, Salatiga. SL target is to engage students in service activities to promote behavioral change and increase awareness of students. The program is known as the "Environmental Service Learning", held in the Gintungan village, Central Java, for 3 days at 2 family farmers. More specifically, these activities aim to provide the opportunity for students to learn about the impact of agricultural practices on human health (farmers) and on the environment. The program is intended for a group of students who have been selected based on their interest and knowledge on issues related to the environment. 8 students from 25 applicants were selected to join the activities of SL give a briefing about environmental service learning, research and participatory field research, the impact of pesticides on human health and the environment, a description of the location of activities, reflection method, engineering reports and presentations.

Prior to the implementation of SL, the faculty give a socialization for the farmers in the Gintungan Gintungan village about the general purpose activities, what activities will be done, as well as the benefits of cooperation in the implementation of SL. There are two families who are willing to be a "landlord" in the program in the year 2013. Students were divided into two groups, 4 people each group, staying with family farmers for 3 days. During the three days, they explore rice fields around them, helping farmers like farming activities in the fields, harvest the fruit, flowers, and vegetables, as well as helping to sell agricultural products in traditional markets Bandungan, Semarang. Students also help perform routine chores, such as cooking, cleaning, and child care.

After the SL activity is completed, students reflect on what they have learned during the SL activities and how the service activities that they have done in environmental issues, such as the effects of pesticides on the health of farmers and the environment. Reflection of students showed that SL has changed student’s perceptions of their role on the environment. SL is also improving academic skills for students such as communication, team-building, and critical thinking.

MacFall & Braun (2007) provides an overview of workhop given to the ESA Annual Meeting, San Jose, California, on August 5, 2007. This workshop is given to teachers who want to implement SL in the ecology class. From the workshop found that many of the approaches that can be done in aplication of SL in the ecology class. Activities that can be done for example testing, monitoring and assessment of environmental quality; collaborate with teachers in local schools to identify plants, manufacture of herbarium; involve students to conduct research projects to observe animal behavior; and so forth.

IV. CONCLUSION

From the above study can be concluded as follows:

1. Service learning is a teaching method that combines learning materials in the classroom with activities of service to the community, through a process of reflection, which can enhance student’s understanding of the learning concept. Service learning develops from a foundation philosophy of progressivism, experimentalists, and experiential of John Dewey. Development motivated by three things: (1) the lack of relevance of the curriculum with the real world, (2) lack of commitment of teacher in the learning process, and (3) lack of a response from institutions on community issues.
2. The basic principle of the implementation of service learning in the learning consists of four components, (1) concrete experience, (2) observation and reflection on the experience, (3) the establishment and the development of concepts based on reflection, and (4) active experimentation to test a concept in a new situation. The fourth component is forming a cycle of learning. The steps in the implementation of service learning known as IPARD (Investigation, Planning and Prepare, Action, Reflection, and Demonstration).
3. Service learning can improve learning outcomes of cognitive/learning achievement, affective, character, involvement in school, motivation, and the ability to think critically.
4. Service learning in biology class is done by adjusting the learning materials to the problems in the target communities. Two studies in the review showed a slightly different procedure. In the study from Handoyo (2015), service learning is integrated with learning, and in Nugroho & Sucahyo study (2013), service learning is outside the classroom learning.

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BE – 05

Implementation of Performance Assessment to Increase Biology Learning Achievement by Using Inquiry Model-Based Lesson Study

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Abstract-This study is conducted in order to understand the performance assessment implementation to increase Biology learning achievement by using inqury model. The Study used action research type- based lesson study. Lesson study stages included planning, doing, and observing. The action reseach was conducted in two cycles. Each cycle was performed in three meetings. Data collection process started in 16 May until 26 September 2015. The subjects of the study consisted of students XI MIA 5 of High School 1 Lawang, periode of 2015/2016 comprising 14 male students and 19 female students. The instruments of data collection were performance assessment instruments consisting of observation rubric, self assessment rubric, and learning achievement test. The result of the research showed that the implementation of performance assessment by using inquiry model could increase biology learning achievement of students XI MIA 5 of High School 1 Lawang. Beside, the result of the research could be used as a reference for teachers in conducting better learning process by lesson study.

Keyword: performance assessment, inquiry model, lesson study

I. INTRODUCTION

2013 curriculum applies activity-based instruction which is expected to result in quality Indonesian citizen who are productive, creative, inovative, and affective through integrated empowerment on attitude, knowledge, and skill. Student's learning achievement on the three aspects can solely be assessed by various methods; one of them is performance assessment. Stiggins (1994) states that performance assessment can be used to measure knowledge, skills, and attitudes. According to Airasin (1994) performance assessment has a number of strengths, namely, 1) assessment that can make the students apply answers or results through demonstrating or performing their knowledge, skills or performance, 2) motivating the students during learning in a more sufficient way, 3) Encouraging application of learning outcome into the real situation. This is because performance assessment highlights on what the students can do, but not on what is known.

The observation and interview results from March to April 2014 in some senior high schools in Malang district found that 1) Teachers had carried carried out the instructional activities very well. The instructional activities designed by the teachers had already focused on discussion and practice method, but the process had not reflected holistic inquiry. For example, the activities was not initiated by brainstorming about everyday life issues required to be solved scientifically. Additionally, during laboratory activities on plant-cellular structure and network the teachers had not benefitted from the surrounding plants for microscopic observation, and the students were only limited to observe a preserved preparation. As a consequeence, the students had not been able to value the given content, 2) In general, the assessments given by the teachers were less varied in terms of methods and instruments. The assessment was chiefly devoted to mastery of content which was used for an objective test serving for low level cognition like memorizing, 3) the teachers had not fully understood and carrieed out performance assessment. Based on the forementioned problems, it is necessary to have revision on instructional activities by implementing performance assessment using lesson-study-based inquiry model.

Assessment is often considered as one of three main principles determining instructional activities. The three principles are, planning, implementation, and assessment. If the three principles work synergetically and sustainably, this will heavily determine the instruction quality. Therefore, the assessment must be designed and implemented according to instructional planning and implementation.

Hart (2014) believed that teachers should have changed their way of assessing the students, as matter of fact, they also needed to change the way they teach and the way the student learn. According to Marzano (1993), performance is authentic assessment that can serve as effective media to measure complex skills or sort of skills which cannot be measured by paper and pencil based test. Measurable skills like planning, investigating, communicating, problem solving, and reasoning skills are included in inquiry stage. On the other hand, according to Llwellyn (2013), inquiry learning is defined as an active scientific exploration process instructing students to use their reasoning ability, logic, and creativity. The students are encouraged by their curiosity to investigate towards phenomena they observe during instruction. The students, then, are able to spur questions or problems, to choose actions and to carry out investigation procedures, to collect and analyze data through observation activities and to derive a conclusion from the instruction in the class.

II. RESEARCH METHOD

The research Methodology used for this study was a qualitative method with classroom action research. Classroom action research model of Kemmis and Taggart (1988) applied two cycles, namely a spiral form from one cycle to the next cycle. Each cycle included *planning*, *action*, *observation*, and *reflection*. The next step in the cycle comprised the already revised plan, action, observation, and reflection. Before implementing the first cycle, a preliminary action was taken by identifying problems. The research was conducted in the class XI MIA 5 SMAN 1 Lawang with a total of 33 students in May - September 2015.

III. RESULT AND DISCUSSION

The research on the implementation of performance assessment to increase the students' learning achievement was carried out within two cycles. Every cycle consisted of planning, action, observation, and reflection. This research was conducted and based on lesson study, comprising 3 stages, namely, plan, do and see. Therefore, the planning stage in the classroom action research was carried out collaboratively within a biology MGMP group in Malang. Meanwhile, 'do" and 'see' stages were held on the classroom action research stages, included in the observation and reflection. According to the observation activities held on the action stage, the result was obtained. Data collection from learning result consisted of aspects, namely, attitudes, skill performance on microscopic observation and delivery skills. In terms of delivery skills, knowledge aspect was also found and these entailed clarity in delivering new knowledge, the depth of content, and argumentation skills.

The labored instrument wa an observation sheet. The comparison of learning result, attitude aspect from cycle one and cycle two are presented below on figure 1.

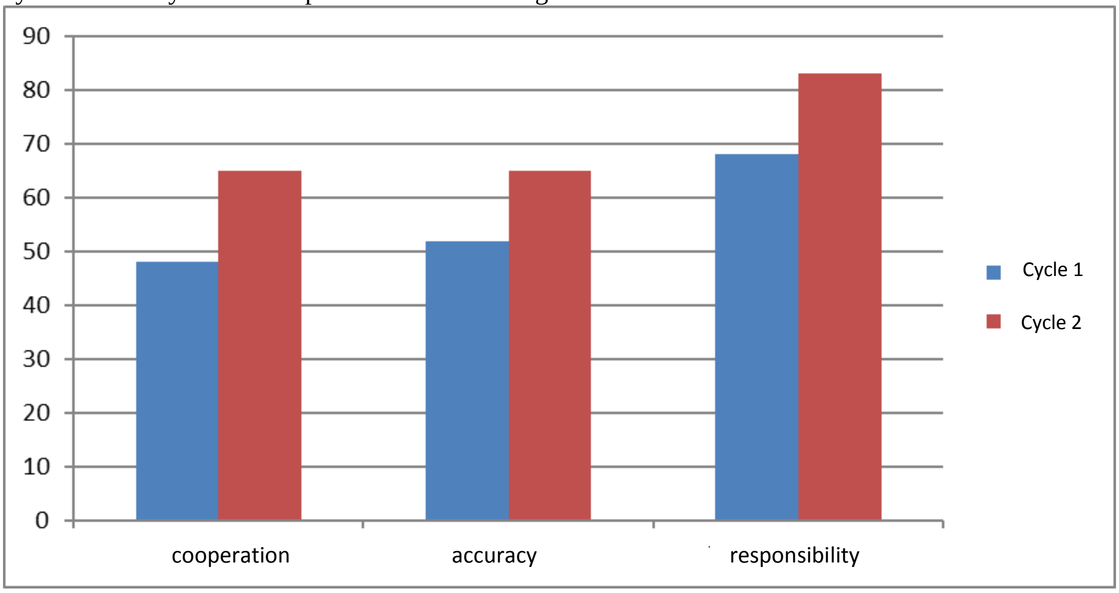

Figure 1. The comparison of social attitudes on cycle I and cycle II

Performance skills on microscopic observation was presented on Figure 2.

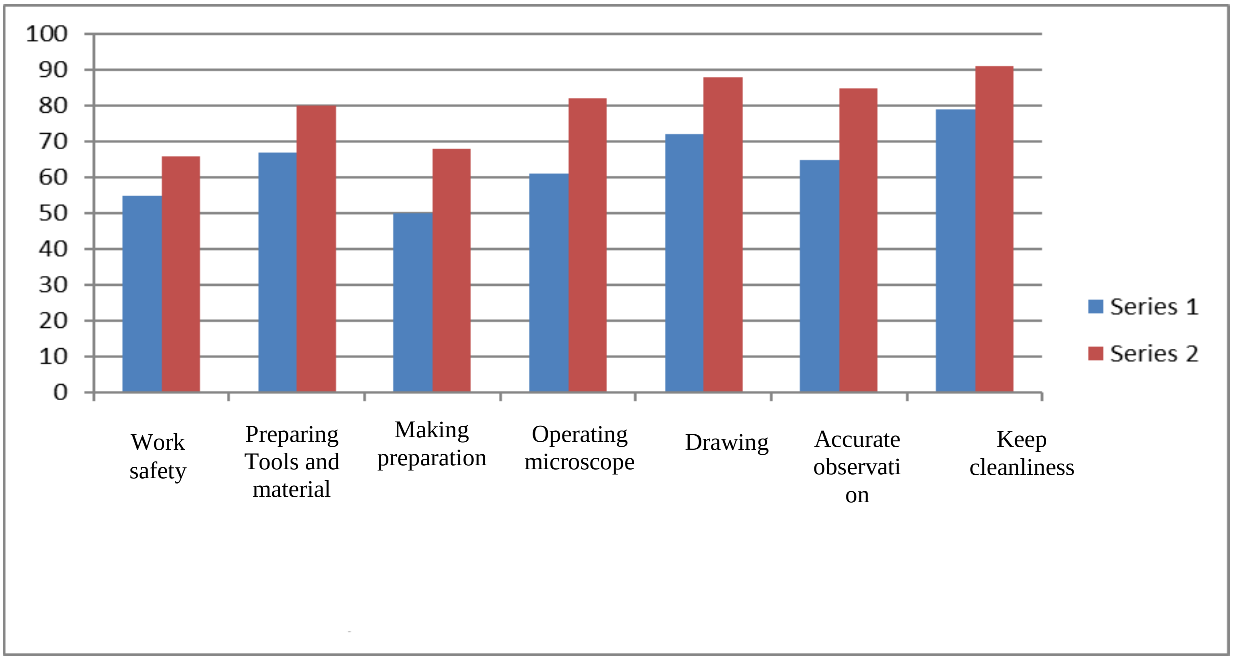

Figure 2 the comparison of performance assessment on microscopic observation on cycle I and cycle II

The following performance assessment is delivery skills on figure 3

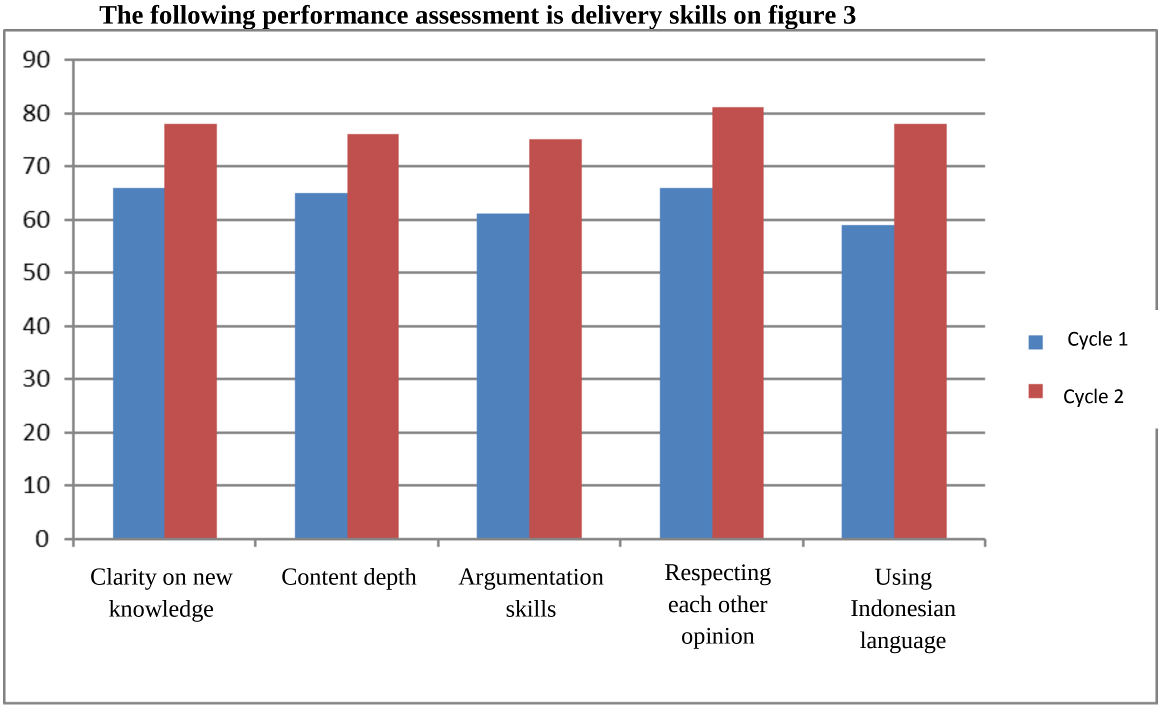

Figure 3. The comparison of delivery skills

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Discussion

The classroom action research were conducted within two cycles in XI MIA 5 SMAN Lawang based on lesson study. This was due to that lesson study was a program to develop teachers' professionalism. The implementation of 2013 curriculum expected teachers to be able to carry out duties professionally. The unfulfilled professional demand can be a major problem for the implementation of 2013 curriculum. In the planning activities there was a discussion on collaborative instruction by the members of MGMP group and the discussion results were met in which the chosen basic competency included Basic competency 3.1; 3.2; 3.3 and 3.4. The reason behind the chosen basic competency was that the complexity level it occupied was considered high to be implemented during teaching and learning activities. Susilo (2009) satetd that one of the reasons on why lesson study was essensially to be carried on was that the teacher would be able to translate basic competency collaboratively, especially the purpose and the standard of education whic was turned into real class activities, initiated by planning activities, instructional instruments, Do (action), and see (observation, reflection toward observation results).

The instructional model conducted was a guided enquiry model. This is because the students were not yet familiar to do complete enquiry model. Llwellyn (2013) classifies enquiry model based on teacher-student dominance level. There are 4 types of demonstrated enquiry or discrepent events, structured enquiry, guided enquiry and full enquiry. The stages of guided inquiry are relevant to scientific approach in 2013 curriculum. During planning activities, apart from determining the instructional model, assessment method must be following. Hart (2014) argued that the teachers should change the instructional method by changing the assessment method because if the teachers change the way they assess students' learning, they also have to change the way they teach and the way the students learn. Based on that reason, therefore, performance assessment proposed by Stiggins (1994) was applicable to be implemented to measure knowledgeaspect, skills, and attitudes.

The research result showed an increase in students' learning and social attitudes from cycle I and cycle II as much as 15.25%. During lesson study on 'do' and 'see' stages depicted that the teachers in Senior High School of Malang Region had not been familiar to measure attitude aspect. In general, the problem relied on limited time to assess through observation sheet. As a consequence, it was quite often for the teachers to use questionnaires filled by the studentsThis would decrease the value of objectivity. Thus, observation sheet was needed. To add, attitude aspects measured also needed to be highlighted, in which they must be highly relevant to the content during instructional process. Moreover, the number of attitude aspects should not be too many. Competency assessment on attitudes is a series of activities designed to measure students' attitudes resulted from an instructional program. Likewise, attitude assessment is a kind of the implementation of an instructional standard or system of decision making towards attitudes. The main purpose of attitude assessment is a part of reflection and reasoning instruction, and student's indiviual progress toward attitudes

The following measured learning result was performance on microscopic observation skills and the result indicated a rise from cycle I to cycle II at 15.80%. In 2013 curriculum the students are advised not to be passively assissted during learning, but they are advised to do discovery, so that there was a need to facilitate classroom activities with guided inquiry model. This interesting finding found during lesson study activity especially on 'do' and 'see' stages was that the biology teachers in implementing inquiry model were not as complete as it was. So that the students could not develop their prosess of inquiry. Guided inquiry model according Llwelyn (2013) has stages as follow: exploring a phenomenon, focusing on question, planning investigation, conducting an experiment, analyzing data, synthesizing new knowledge, and disseminating the new knowledge. The implementation of guided inquiry model of the first cycle according to teachers achieved 90%; it means that the quality of the instruction by the teachers was categorized good.

Assessment is an activity that chiefly determines the quality of instruction. However, the implementation of performance assessment needs a suitable instructional strategy. One of the instructional strategies allowing a student to invent knowledge individually as well as to participate actively in the instruction so that they can understand a concept very well, and being able to develop critical thinking ability refers to inquiry instructional strategy. An inquiry instruction strategy is a series of activities involving fully maximized learning activities developed hollistically within student's ability to search and investigate systematically, critically, logically, and analytically. Therefore, the students are able to independently formulate his/her invention fully confidently. Based on that reason, the three principles, namely, planning, implementation, and assessment must have been synergetically established and sustained, and it will obviously determine the quality of an instruction.

The result of the study on cycle I and cycle II on delivery skill showed an increase at 14.48%. The aspects being measured were 1) clarity in delivery new knowledge, 2) the depth of the content, 3) the ability in argumentation, 4) respecting other people's opinion, 5) using Indonesian languageThe forementioned 5 aspects being measured could not be valued using paper and pencil test so that performance assessment was needed. As Stiggin (1994) argues, there are several reasons why performance assessment needs to be conducted in a class, those reasons are: 1) giving more opportunities to teachers to know the students even more hollistically because; in fact, not all students who are less successful in an objective test or an open answer test are usually acknowledged as not skillful or not creative, 2) being able to witness the students' skills performed during the instruction process without waiting even until the lesson ends, 3) there are skills developed by the students which are not easily observable through solely referring to a written test or the final result of their assignment.

IV. CLOSING

Conclusion

The implementation of inquiry model of performance assessment could improve the learning result of students on Grade XI MIA of SMAN 5 Lawang. The learning result on social attitudes increased from cycle I to cycle II at 15.24% while performance on microscopic observation skills comprised 15.80%,and delivery aspect also obtained an increase at 14.48%. Moreover, the activity of lesson study was also found to improve the instruction quality through collaboratively and continuosly discussing the instructional activities based on partnership principle and mutual learning, as well as establishing a learning community.

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BE - 06

THE ISOLATION OF LEUKOCYTES IN THE BLOOD OF CATTLE AS LEARNING MEDIA CYTOLOGY-HISTOLOGY

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Abstract-Higher Education National Standard of Regulation Minister of Research, Technology and Higher Education Republic of Indonesia number 44 in 2015 is a standard that includes Education National Standards coupled with Research National Standards and Community Service Standards. One of the National Standard of Education is learning process. The task of the lecturer are professional educators and scientists with the main task of transforming, developing and disseminating science, technology through education, research and community service. The course developed in biology department of education, faculty of mathematic and sciences, Ganesha University of Education located in Singaraja Bali is cytology-histology with a load of 3 credits. Subject of cytology-histology with load 3 credits consisting 2 credits lectures and 1 credit experiment. Development referred is development of experiment is observation forms leukocytes. This is based on one of the problems encountered in experiment cytology-histology is not available practical guidebook. Prosedure have been using leukocytes isolation, observation preparations clarity ratings. Based on the assessment instrument that has been rated by the university students (there are three classes included class A, B and C) to assess the clarrity of forms leukocytes were observed, class A has declared 100% clearly observed, class B has declared 76 % clearly observed and 24% have expressed less clearly observed and class C declared only 7% clearly observed and 93% have expressed less clearly observed. Forms of leukocytes that have been succesfully observed is monocytes included monocytes and lymfocytes, neutrophyls, eosynophyls and basophyls.

Keywords *: assessment, education,learningmedia,*

I. INTRODUCTION

Higher Education National Standard of Regulation Minister of Research, Technology and Higher Education Republic of Indonesia number 44 in 2015 is a standard that includes Education National Standards coupled with Research National Standards and Community Service Standards. Higher Education is education after secondary education covers (a) education diploma; (b) undergraduate; (c) master program (graduate); (c) doctoral programs (graduate) (d) proffessional programs (e) specialist programs that organized by the college based the Indonesian culture. Higher Education National Standard comprising: (a). a graduate of a competition standard; (b) the standard of learning content; (c) learning process standards; (c) assessment standards of learning; (d) lecturer and education personnel standards; (e) facilities and infrastructure standards of learning; (f) learning management standards and (g) the standards of learning financing [12].

One of the National Standard of Education is learning process. Learning is the process of university student interaction with lecturer and learning resources a learning environment. Process standard covers : characteristic of learning process, planning the learning process, the implementation of the learning process and the burden of university student learning. The lecturer are professional educators and scientists with the main task of transforming, developing and disseminating science, technology through education, research and community service[12].

The course to be developed in Biology department of education, faculty of Mathematic and Sciences, Ganesha University of Education is cytology-histology. Those subject with a load 3 semester credit units. Semester credit units and furthermore abbreviated SCU is dosing time credits are charged to learning activities per week per semester university student in learning process through various forms of learning or recognition of magnitude of effort succes university student in following the curricular in a course. Cytology-histology course with a load 3 SCU which consists of 2 SCU lectures and 1 SCU practicum activities or 3(1) [11]. As stated in Regulation Minister of Research, Technology and Higher Education Republic of Indonesia number 44 in 2015 on higher education standards, forms of learning can be (a) lectures, (b) responsiveness and tutorials, (c) seminars and (d) practicum, studio practice, practice workshops or field trips. One SCU in learning process is practicum studio practice, practice workshops, field trips, research, community service, and or other similar learning process, 170 (one hundred and seventy) minutes per week per semester [12].

Development referred to in this paper is the development and manufacture of practical guidance. This is based on one of the problems encountered in Biology department of education, faculty of mathematic and sciences, Ganesha University of education located in Singaraja Bali in practicum cytology-histology is not available practical guidebook. One of those practicum observation blood preparations. Preparations available in Biologi Department of Education faculty of Mathematic and Sciences Ganesha University of Education is preparation preserved red blood cells of human and chicken. Preparations the other types of blood cells such as white blood cells are not available so that university student do not observe of white blood cells. To introduction of various forms of white blood cells studied teoretically.

Based on the backround, the author to develop and make practical guidance regarding the isolation and observation forms leucocytes so that one of the learning process on the subject of blood reached, in accordance with Regulation Minister of Research, Technology and Higher Education Republic of Indonesia number 44 in 2015. The prosedure isolation white blood cells from cattle used was adopted from Widiyanti [14]. Cattle were killed in cattle slaughterhouse located in Singaraja-Bali. The reason is the use of cattle blood in terms of materials, requires no special preparation. To know clarity observation asess by instruments.

II. METHODS

2.1 Type of experiment is exploratif

2.2 Located

Location of experiment is cattle slaughterhouse located in Singaraja-Bali for collected of blood sample. While the process of making preparations and observations have been made in the microbiology laboratory Biology department of education faculty of mathematic and sciences Ganesha University of Education. Observation were made collaboratively between university students and lecturer.

2.3 Subject and Object

Subject

1. Subject in this research is blood cattle
2. University student semester 3 academic year 2014/2015

Object

1. Object this research is 50 ml blood cattle that has been collected from cattle slaughterhouse.
2. University student semester 3 academic year 2014/2015

2.4 Research Procedure

Research procedure making preparations, are follows,

2.4.1 Making preparations and observation :

1. Cattle blood collecting 50 ml into tubes already containing 5 ml EDTA
2. Take 10 ml of blood from the parent tube
3. Separating the components of blood by histopaque 1077 (Sigma) a way to add it to the blood sample
4. Isolating the middle part of blood is white blood cells located between the blood plasma and red blood cells using a pasteur pippette.
5. Placing the isolation of leucocytes in centrifuge tubes
6. Phosphate Buffer Saline (PBS) adds up to 10 ml volume tube to wash the blood cells.

7. Blood centrifuges at 1500 rpm for 5 minutes
8. Washing done 3 times
9. Adding a solution of Turk (Nacalai) for coloring the cell
10. Leukocytes isolated placed on a glass slide
11. Observations were made under a microscope to identify the forms of leukocytes.

2.4.2 Assessment preparations and clarity of observation :

After observation, university students fill out the instruments form on the results of making preparations and clarity of observation.

Data Analysis

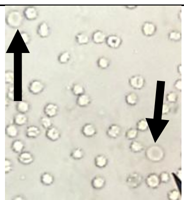
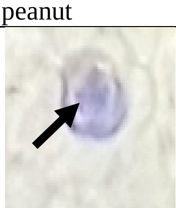
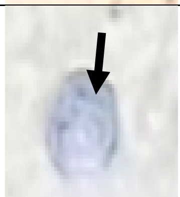
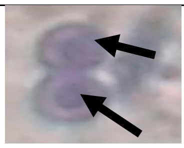
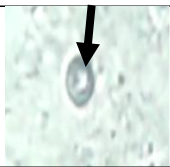
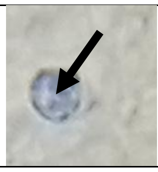
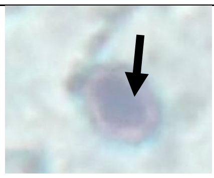
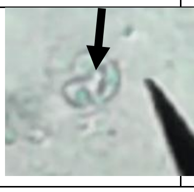
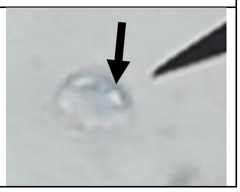
1. Data about the results making preparation were analyzed descriptively
2. Data about the clarity preparation by instruments ratings were analyzed descriptively

III. RESULTS THE RESEARCH

a. Results Preparation of blood

The results of observation preparations made by university students in accordance with the procedures and university students observations collaboration with lecturer as stated in the table 1. below

Table 1. Forms of leukocytes observation under the microscope

Type leukocytes	Lympcocytes	Neutrophyls	Makrophages	Basophyls	Eosinophyls
Characteristic morfology cells	White blood cells with 1 nuclear cell, form is cyrcular/rounded	Nuclear lobes is 3-5	White blood cells with 1 nuclear cell, form is like peanut	Nuclear lobes is 2, form U/S	Nuclear lobes is 2 (bilobed)
Pictures					
					
					
					

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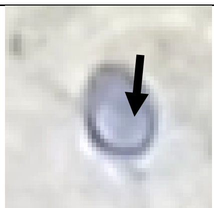
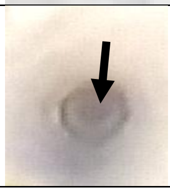
					
		Arrow show nuclear cells			

b. Results asessment instruments fill out by university students

Results of assess by university students as table 2 bellow.

Table 2. Results assess instrument preparations

Clarity observation preparations	**Class A**	**Class B**	**Class C**
Obivious	100%	76%	7%
Less clear	0%	24%	93%

IV. DISCUSSION

Haematology in old Greek, *haemat* means blood and /*o*/-*logy* means investigation or examination. Thus, *haematology* refers to the examination of blood. Multicellular animal organisms need the circulatory system to transport food particles and respiratory gases to the cells in tissues and to carry the wastes from cells to the necessary organs. Blood is the circulatory fluid in vertebrates. Keeping both the components and the amount of blood at a constant level is essential for the continuity of life. Composition of Blood including blood corpuscles, or blood cells (*erythrocytes*, *leukocytes* and *thrombocytes*), and the liquid intercellular substance are a type of specialized connective tissue of mesenchymal origin originating from the *blood plasma*. Plasma consists of water, food substances, wastes, hormones, antibodies and enzymes [4].

Blood plasma is straw-colored, sticky fluid. Although is about 90% water, it contains over 100 different kinds of molecules, including ions suc as Na^+, Cl^-, nutrients suc as simple sugar, amino acids and lipids, waste such as urea, ammonia and carbon dioxide, and oxygen, hormones and vitamins. Plasma also contains 3 main types of protein : albumin, globulins and fibrinogen [6]. Formation of blood like plasma originates from the intestines and different organs of the body. Water and food substances come from the intestines, whereas wastes, hormones, antibodies and enzymes come from different organs in the body [4].

Erythrocytes (red blood cells or rbc): occupy about 40-45% of the total blood volume or 30 ml/kg body weight (Gartner & Hiat). When development from pluripoten cells to normoblast, nucleus and most of organells ejected such as mitochondria, golgi,endoplasmic reticullum and the cells collapses and assumes its biconccave. The cells now retyculocyte, a young erythrocyte that contains a network (reticulum=network), representing clumps of ribosoms that remain after the other organelles are extruded. Reticulocytes enter the blood-stream and begin their task [6]. Red blood cells fulfilled the following 3 major functions of red blood cells: (1) oxygen transport [16] (2) carbon dioxide transport [17] and (3) antioxidant functions [18]. HBOC (Hemoglobin Based Oxygen Carriers) only has one of the 3 major functions of red blood cells. However, the risk/benefit ratios of polyhemoglobin have already been shown in situation where rbc is not available (Jahr *et al*, 2008). Erythrocytes remain in the reticulocyte stage for their first day or two in the cyrculation, after which their ribosomes are degraded by intracellular enzymes and lost. The last for 1-2 days of approximatelly 100-days life span of erythrocytes [6].

White blood cells are an important component of the host defence system, responsible for protection against bacteria, fungi, viruses, and invading parasites. An intricate cytokine network and hierarchy of progenitor cells maintain baseline myelopoiesis and also allow rapid adjustment in the rates of production of these cell types that occur in response to acute and chronic stress. White blood cells originate from pluripotent haemopoietic stem cells [5] [12]. Under the influence of various external stimuli (cytokines, matrix proteins, and accessory cells), stem cells develop into haemopoietic progenitor cells of various lineages [12]. Growth factors that regulate the development of particular populations of white blood cells have been identified [5] [12]. There are 2 types of white blood cells (WBC) :

1. Granulocytes are granule-containing WBCs. They have lobed nuclei, which typically consist of several rounded nuclear areas connected by thin strands of nuclear material. The granules in their cytoplasm

stain specifically with Wright's stain. The granulocytes include the neutrophils, eosinophils and basophils . Neutrophils have a multilobed nucleus (3-5lobes) and very fine granules that respond to both acid and basic stains. Consequently, the cytoplasm as a whole stains pink. Neutrophils are avid phagocytes at sites of acute infection [19]. For neutrophils, production involves several different growth factors, including granulocyte-colony-stimulating factor (G-CSF), granulocyte-macrophage-colony stimulating factor (GM-CSF), interleukin 3, and macrophage-colony-stimulating factor (M-CSF). In steady-state granulocyte production, G-CSF rather than GM-CSF is the most important lineage-specific factor according to findings in knockout mice. Similarly, for monocytes, both GM-CSF and M-CSF control number and function in vitro, but in mice only M-CSF deficiency leads to profound monocytopenia and macrophage deficiency. Neutrophils make up more than half of all leucocytes and are the dominant class of circulating phagocytes (normal count 1·8–7·7_109/L).3 They are the front line in defence against bacterial infections. The largest pool of neutrophils is in the marrow (reserve pool), and a small number circulate in the peripheral blood (circulating pool); a number similar to that of the circulating pool exists in tissues (tissue pool). The circulating pool can be further subdivided into two roughly equal compartments: a marginated pool of cells loosely adherent to vascular endothelium, and a freely circulating pool. Only the latter can be counted. Stress (exercise) causes a transient increase in the freely circulating pool [3] . Corticosteroids promote release of neutrophils from the marrow storage pool into the circulation and also inhibit movement of these cells from the blood into the tissues, resulting in an increased measured white-cell count. Intravascular activation of neutrophils (C5a, endotoxin) results in increased margination and hence a decrease in the measured neutrophil count. The half-life of a circulating neutrophil is short (6–8 h) [8].

Eosinophils have a bilobed blue-red nucleus that resembles an oldfashioned telephone receiver and large red cytoplasmic granules. Their number increases rapidly during allergies and infections by parasitic worms (flat-worms, tapeworms, etc.) [19]. The production of eosinophils depends on GM-CSF and interleukins 3 and 5. Interleukin 5, however, is the most lineage-specific factor and acts by promoting eosinophil production and prolonging survival of eosinophils. Mature eosinophils, which make up 5–10% of granulocytes (0·2_109/L), have a bilobed nucleus and numerous orange cytoplasmic granules. Eosinophils have substantial proinflammatory and cytotoxic activity and play an important part in the pathogenesis of various allergic, parasitic, and neoplastic disease processes [3].

Basophils, the rarest of the WBCs, have S shaped nucleus contain large histamine-containing granules that stain dark blue. Histamine is an inflammatory chemical that makes blood vessels leaky and attracts other WBCs to the inflammatory site [19]. Basophils are the least common granulocytes and are distinguished from eosinophils by large metachromatic (purple-black) granules rich in histamine, serotonin, and leukotrienes [9]. Mast cells are related to, but distinct from, basophils. Basophils are bilobed, whereas mast cells are long-lived cells that reside in tissues rather than peripheral blood and are capable of cell division. Both cell types are involved in immediate and cutaneous hypersensitivity reactions including asthma, urticaria, allergic rhinitis, and anaphylaxis [18].

2. Agranulocytes lack visible cytoplasmic granules. Their nuclei are spherical oval or kidney-shaped. The agranulocytes include lymphocytes and monocytes. Lymphocytes have a large dark purple nucleus that occupies most of the cell volume. Only slightly larger than RBCs, lymphocytes reside in lymphatic tissues, where they play an important role in the immune response. The lymphocytes function mainly in connection with the immune system. However, a function of certain lymphocytes is to attach themselves to specific invading organisms and destroy them, an action similar to those of the granulocytes and monocytes [19]. Lymphocytes represent about a third of the white blood cells in the peripheral blood (1·0–4·0_109/L). Most have a compact rounded or gently notched nucleus with scant agranular cytoplasm. B and T lymphocytes cannot be distinguished morphologically. Some 10% of lymphocytes are large granular lymphocytes, characterised by abundant cytoplasm and reddish granules. These cells are called natural killer cells because of their ability to destroy virus infected and HLA-incompatible target cells [15]. There are two types of lymphocytes:

a. T lymphocytes: provide cell mediated immunity [19] [1]. Two thirds are T cells, which participate in cell-mediated immune responses.The control of T lymphocytes is a complex process; although interleukins 2 and 15 both have important roles in T-cell growth and activation, interleukin-2-knockout mice do not have lymphopenia [3].

b. B lymphocytes: provide humoral immunity [19]; [1]. Although many growth factors affect B-cell lymphopoiesis, studies of mice without the genes for interleukin 7 or its receptor showed that only interleukin 7 is an obligate B-cell growth factor. The remainder are B cells, which are programmed to produce antibodies [3].

Monocytes are the largest of the WBCs. Except for their more abundant cytoplasm and indented (kidney like) nucleus, they resemble large lymphocytes. When they migrate into the tissues, they change into macrophages. Macrophages are very important in fighting chronic infections, such as tuberculosis [19]. for monocytes, both GM-CSF and M-CSF control number and function in vitro, but in mice only M-CSF deficiency leads to profound monocytopenia and macrophage deficiencyThe granulocytes and the monocytes protect the body against invading organisms by ingesting them by the process of *phagocytosis* [19]. 3–8% of circulating leucocytes are monocytes (0·3_109/L), which are characterised by their large size and folded nuclei. After migration into extravascular tissues, they increase in size and acquire the morphological characteristics of tissue macrophages. Macrophages and monocytes play an important part in regulating the afferent and efferent components of the immune system [15].

Based on the results of the assessment of preparations and observations of university students as much as 3 classes; class A : 100% stating the obvious, class b 76% stating obvious and 24% said less clear. While class C: only 7% who stated obvious and 93% stated less clear. Obscurity preparations were observed by the university students due :

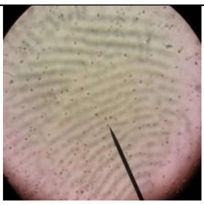
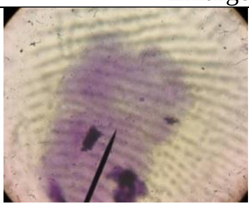
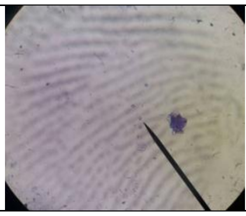
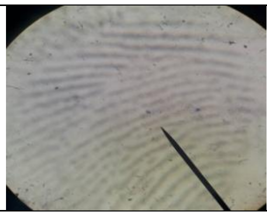
1. Unpreparedness of university students will be doing practical espicially in the basic theory about the forms of leukocytes
2. Practical guidance provided to university students still in the form of power point
3. The laboratory equipment used are new
4. University student do not have skill to collected of white blood cells so that all types of cells isolated
5. University student do not understand the function and the names of the chemicals used
6. The time available for 3 hours practicum is not enough for making preparations and observation of results.
7. Eyestrain, small cell size and the number of blood cells, often resulting in errors in the process of observation like stated [2] stated eyestrain, small cell size and the number of blood cells, often resulting in errors in the process of manual counting.

As a result of the documentation overview leukocytes by university students, espically university student who expressed less obvious is follows.

Class C

From the visible image, the result is documentation that the university student shows a picture forms of leukocytes is less clear as table 3 bellow.

Table 3. The documentations less clear preparations

<table>
<tr><td>Picture 1</td><td>Pictures 2</td><td>Pictures 3</td><td>Pictures 4</td></tr>
<tr><td colspan="4" align="center">Enlargement 10 x 40x</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>The result is the erythrocytes and platelets documentation</td><td>The result : no visible blood cells</td><td>The result : no visible blood cells</td><td>The result : no visible blood cells</td></tr>
</table>

V. CLOSING

1. Forms of leukocytes were observed in the development of learning cytology-histology are lymphocytes, monocytes, neutrophyls, eosinophyls and basophyls
2. Based on the assessment instrument that has been rated by the university students (there are three classes included class A, B and C) to assess the clarrity of forms leukocytes were observed, class A has declared 100% clearly observed, class B has declared 76 % clearly observed and 24% have expressed less clearly observed and class C declared only 7% clearly observed and 93% have expressed less clearly observed.
3. Collaborative learning university student-lecturer are indispensable to obtain lab results better

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BE – 07

The Effect of Problem- Based Learning on Critical Thinking Skills and Student Achievement

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Abstract- The purposes of this study are (1) to know the effect of Problem-Based Learning on critical thinking, (2) to know the effect of Problem-Based Learning on student achievement in cognitive aspects, (3) to know the relationship between critical thinking and student achievement in cognitive aspects in Environmental Pollution of 10th Grade in The 1 Bantul Senior High School. The research was quasi experimental research using a control group pretest-posttest design. Sample was X IPA 5 as an experimental group while X IPA 6 as a control group. Data collection methods in this study were observation sheets, videos, photos, student's critical thinking skills data, and student's achiement data in cognitive aspect. Instruments that were used in this study were instrument to collect the implementation of PBL, intrument to collect the student's critical thinking skills and also student's achievement in cognitive aspect. Data analysis techniques were normality and homogeneity test, t test, analysis of covariance (ANACOVA), and Pearson correlation. The results show that (1) Problem-Based Learning affects critical thinking, (2) Problem-Based Learning affects student achievement in cognitive aspects, and (3) there was a significant relationship between critical thinking and student achievement in cognitive aspects. The higher critical thinking is, the higher student achievement especially cognitive aspects of the students.

Keywords: problem- based learning (PBL), critical thinking, student achievement, cognitive aspects

I. INTRODUCTION

In a rapidly changing world, every person is challanged to fullfill the global demand especially in developing skills. The impact of the rapid cahange in society to education is that education must prepare generation to have a certain skill needed by the society. The skills are called 21st century skills. Partnership for 21st Century Skills [1] has developed 21st century skills that consist of life and career skills, learning and innovation skills, and information media and technology skills. Teaching and learning process does not only increase student's knowledge but also develop student's creativity, critical thinking skill, characters which are included the character to has responsibility, social skills, tolerance, productivity, and adaptive skills. 21st century skills also emphasize on the ability to think critically, solve problem, communicate, and collaborate each others [2] that are included in Higher Order Thinking Skills.

Problem- Based Learning (PBL) is teaching and learning model that provide contextual problems to the classroom, so that teacher can stimulate students to learn [3]. PBL is a teaching and learning model that present many anuthentic problems and meaningfull to the students [4]. Teaching and learning process using PBL challenges students to learn, work in group to look for the solution in contextual problem. Teaching and learning process is directed to student in order to develop student's ability in making solutions systematically.

PBL has five characteristics that need to be considered by teachers before designing the lesson plan using PBL model. The first characteristic is presenting essential question that is included problems. The others characteristic are PBL focuses on the relationship between interdisiplinary study, authentic investigation, publication of the artifact, and colaboration [4]. There are five operational steps from PBL, (1) giving orientation about the problem that will be discussed by student, (2) organizing students to do research, (3) helping students to investigate the problem, (4) developing and exhibiting the artefact, and (5) analysing and evaluating problem solving process [4].

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Critical thinking is the process of complex thinking to analyse question or argument and generalize meaning and specific interpretation through logical thinking and understanding assumptions. The student's critical thinking ability can be identified by implementing proper teaching and learning model such as PBL model. Students who involved in PBL have critical thinking ability higher than students who involved in traditional teaching and learning model [5]. Teaching and learning process using PBL encourages student to think critically by presenting the extraordinary problems which the solution cannot be solved using common ways of thinking [6].

Student's achievment is student's skills that achived by students after teaching and learning process. One of student's achiement that can be measured is cognitive aspect. According to revised Bloom Taxonomy [7] there are six aspects: (1) remember, (2) understand, (3) apply, (4) analysis, (5) evaluate, aand (6) create

There are several advantages in using PBL as one of teaching and learning models. By using PBL increases student's undertanding and increasing student;s activites during teaching and learning process [8]. PBL helps students in transfering their factual knowledge to understand the contextual problem. PBL also develop student's responsibility and the most importanly is that PBL can increase the student's thinking ability. PBL brings the happines in the classroom through teaching and learning process. By using PBL in classroom, it can increase student's critical thinking and also give student possibility to apply their knowledge in order to solve the problems.

One of senior high schools that has implemented curriculum of 2013 is The 1 Bantul Senior High School. Biology teaching and learning process that is used using 2013 curriculum ideally should develop student's critical thinking skill. One of teaching and learning models that develop critical thinking skills is PBL. However, not all of the teaching and learning process has developed student's critical thinking skill. Teaching and learning process still conducted by teacher give whole information to students using conventional model such as question- answer method. Whereas, critical thinking skills do not merely appear instantly. It needs efforts to develop student's critical thinking skill. This skill, critical thinking, is ability that student should have in achieving learning mastery.

Learning material that is used in this study is environmental pollution. Environmental pollution choosed to be study material because it presents contextual problem that should be solved by student in daily life. This material bring problems that usually faced by student in their daily life. The implementation of PBL is on the Standard Competition 3.10 that it emphasizes on analysing data in environmental changing and the implication in environmental changing. In this material, students are confronted with environmental problem and are demanded to solve problems using critical thinking and also gathering information to solve problem systematically. This material provides dynamic environmental problem. Environmental problems tend to be complex and need to be solved using higher order thinking skills.

Based on the background above, there are three research question for this study (1) what is the effect of PBL to critical thinking?, (2) what is the effect of PBL to student achievement in cognitive aspects?, and (3) is there any relationship between critical thinking and students achievement in cognitive aspects in Environmental Pollution in The 1 Bantul Senior High School?

II. METHOD

This study, which was carried out to know the effecet of PBL to critical thinking and student achievment, was designed according to quasi experiment design using control group pertest- postest design. This research is conducted in The 1 Bantul Senior High School, Bantul Regency, Special Region of Yogyakarta.

Population of this study was students of 10^{th} grade of Science Program in The 1 Bantul Senior High School, which was consisted of two classes, 10^{th} Science Program 5 as experimental group and $10t^{h}$ Science Program 6 as control group.

The dependent variable of this study was PBL that consists of five steps, (1) problem orientation, (2) study organization, (3) individual and group investigation, (4) presentation, and (5) analysis and evaluation. The independent variables in this study were critical thinking and student's achievement focuses on cognitive aspect. The critical thinking aspects measured in this study are interpretation, inference, explanation, analysis, and evaluation. The cognitive aspects measured in this study according to revised Bool Taxonomy are remember, understand, apply, analyse, and evaluate.

The study conducted by determining experiment group and control group by giving treatment which was PBL for experiment group and conventional model for control group. Extraneous variables were also controlled. Data was collected using test (pre test- post test), the implementation of PBL, and student evaluation about the implementation of PBL in class. After data had been taken, data was analysed.

Data collection methods in this study were observation sheets, videos, photos, student's critical thinking skills data, and student's achiement data in cognitive aspect. Instruments that were used in this study were instrument to collect the implementation of PBL, intrument to collect the student's critical thinking skills and also student's achievement in cognitive aspect.

The data obtained in the study were SPSS program version 21. Data analysis that were used were normality test and homogenty test. To know the difference between two groups, T test was used in order to know the difference between experiment group and control group. To know the difference between two groups before and after the implementation of PBL, Pair sampe T test was also used. Covariance analysis is also used to know the influence of covariance to the dependent variables. The relationship between variables were analysed using Pearson Corelation Test.

III. RESULT

Descriptive analysis was conducted to describe the student's critical thinking skills and student's achievemnt. According to descriptive analysis, experiment group had higher result in critical thinking skills and student achievment than control group.

Table 1. Descriptive Analysis of Student's Critical Thinking Skills and Student's Achievement

	Control Group		Experiment Group	
	Critical Thinking	Student Achiement	Critical Thinking	Student Achiement
Mean	66,11	69,33	77,50	79,57
Median	70	72	80	80
Mode	65	76	75	68
Max	85	88	100	100
Min	35	56	35	68
STDV	18,47	16,34	15,37	8,73

As seen on the table above, it was understood that experiment group has higer average on critial thinking (77,50) and student's achievement (79,57) than control group which has 66,11 for critical thinking and 69,33 for student's achievement.

According to Independent Sample T test, there was a significant difference between the median of critical thinking ability (sig. 0,016) and student achievement (sig 0,005) which wass showed by the sig 0,05. According to the result of Paired Sample T Test, there was a difference between berfore and after the implementation of PBL in experiment group, whereas there is no difference in control group before and after the learning process.

Table 2. Pair Sample T- test Result

Group	Aspect	Sig	Result
Control	Critical thinking	0,805	Not difference
	Student achievement	0,0006	Difference
Experiment	Critical thinking	0,014	Difference
	Student achievement	0,000	Difference

According to Covariance Analysis, there was an effect of PBL to student's critical thinking ability and student's achievement which was shown by the sig 0,016 for critical thinking and 0,006 for student achivement. It mens there is a difference between critical thinking and student achievement in the experiment group and control group.

Table 3. Covariance Analysis

Dependent variable	Sig
Critical thinking	0,016
Student achievement	0,006

The result of Pearson Correlation Test to independent variables, critical thinking and student achievement, shows that there was a relationship between thinkinga ability and student achievement. Corelation coeficient in critical thinking and student achiement was 0,406. It means that two independent variables, critical thinking and student achievement, had significant correalation. The correlation between critical thinking and student achievement is positive correlation. It means that the higher critical thinking was, the higher student achievement of the students after involving PBL class.

IV. DISCUSSION

The difference results between control group and experiment are caused by students in experi ment group involve in PBL classroom which is student- centerd learning. PBL gives students opportunities to actively participate during learning process. Students actively discuss for solving the problems provided by teacher about the environmental polution. Students are encouraged to solve the problem using analitical thinking and also encourage them to apply their knowledge in order to solve the given problems. These activities are developing student critical thinking because student are also encouraged to seek and gather the information relating to the problem they will solve. Students are also analaysing and associating the relationship between information relating to the problems. Through all these activities, students have opportunities to think deeply about the environmental concepts that they get through thinking activities during problem solving activities. All those activities are also increasing student’s understanding about environmental polution which has influence to student achievement especially cognitive aspect.

PBL consists of five steps which is begun from (1) problem orientation, (2) student organization, (3) problem investigation, (4) artifact exhibition, and evaluation [4}

1. Problem orientation

   Problem orientation is presented by giving students phenomenons which present the certain environmental problems. The problem orientation activities is introduced to students to solve the problem globally. The enviromental polutions which are presented in the classroom can be air pollution, water pollution, and soul polltion. Problems can be presented to students in videos or articles from local news papers. From the phonemonons, students is guided to analyse the cause of that pollution problems. Students are encouraged to generally deliver thier thoughts about the spesific problem causing the environmental pollution phenomenons. By sharing their thought about the problems, students are introduced to the broad understanding about the problem they must solve during problem investigation.

2. Student organization

   Second step of PBL is student organization. In this steps, students are devided into small groups consist of 4 people. After dividing class into groups, each group made simple group organization which consisted of leader, notulen, and members. After making student organization and giving each student assignments that should be done by students. By making simple organization in each group, students will easly work on group because every student has known their responsibility. It makes them easy to discuss the problem and most importanly they will actively participate in the group discussion by giving their novel ideas.

3. Problem investigation

   Problem investigation can be conducted as individual investigation or group investigation. First activity in problem investigation is finding the problem from the phenomenons that has been presented by student in the beginning of the class. After finding the problems, students will state the problem by maing some questions relating to the phenomenons. However, there always possibility that students have difficulties in formulating problems. Students have not understand yet how to formulate the problem and make it into question. So that teacher must give examples how to formulate the problems into question. After students understand, students are encouraged to write down the question in the black boar, so that every student can see the question made by students in every group. Students, accompanying by teacher, are guided to choose one of the listed questions to be a main problem disscussed in the class. Through formulating the problems into questions, students are guided to the problem solving activities.

   In order to investigate, student must conduct reseach by looking for some information to support their ideas in solving the problem. Students can use many sources such as textbooks, journals, magazines, newspapers, or other sources that can be found online. All of activites in problem investigation are student centerd [4].

   Problem analysis can be carried out after students have collected all of the supported informations. By group discussion, student analyse the cause of the problems and make a conection between causes and effects. Every group also design the strategy to solve the problem sistematically and write the results down as a classroom discussion topics.

4. Artifact exhibition

   Artifact or product can be as a presentation. Presentations are developed based on the group discussion results. Every group must present their result in the classroom so that other groups can give thier opinios in order to exchange information and solve the problems. Teacher concerns is really needed. Teacher must guide and control the discussion, so that every group can deliver their ideas and develop their ideas better. Exibiting the discussion reselut also give student oportunities to develop ther communication skills.

5. Evaluation

   The last syntax in PBL is evaluation. Evaluation consists of evaluation and analysis of the problem solving results. Students actively participate in asking questions to other groups whose results are being presented. Students not only ask questions but also give supported comment or criticism to other group presentations. It also happens to groups whose results are being presented. They also give feedbacks by aswering questions. In the end of presentation sessions, students are asked to draw conclusions and also make a reflection about the learning activities using PBL.

PBL is one of the learning model that encouraging student to identify problems from certain problems that presented in the beginning of the learning activities and also developing students ability in understanding problem better by formulating questions. PBL also gives students opportunities to access wider sources in order to find causes, process, and effect from the given problems which help students find ideas to design the solutions. Organizing students in the small group also makes student easily work in group because every student knows thier assignment and has more chances to deliver thier ideas. It can be concluded that these actvities can develop student understanding better, because student can get a lot of information from many resources and also discuss it in the classroom.

Critical thinking skills that is measured are the ability to make interpretation, inferece, explanation, analysis, and evaluation. The ability to make interpretation can be improved through giving studets problems displayed in data through articles or video. Students then are asked to analyse the casuse and effects of the problem and also formulate the problem in questions. Making inferences can also be developed by analysing the data exposing the certain problems. Students are driven to make a general conclussion about the problem. Explanation skill is one of critical thinking that can be developed by explaining and convincing causes and effect of a phenomenon. In PBL syntax, problem investigation, students are also driven to develop thier ability in analysing a problem by analysing the realationship between causes and effects of a problem. In the end of exhibiting artefact, students are ased to make some evaluation including giving question or supporting comments to other group whose presenting the artefact in order to develoop their ability in evaluating the ideas. These skills, interpretation, inferece, explanation, analysis, and evaluation, are increasing during PBL teaching and learning process because PBL highly motivates and encourages student to use their thinking ability.

According to the result study, it shows that critical thinking skill has correlation with student achiement especially in cognitive aspect which has been stated by revised Bloom Taxonomy. There are five aspect that were measured in this study. There were remember, understand, apply, analyze, and evaluate. During teaching and learning activities using PBL, there are many activities that facilitate students to develope their thinking ability including Lower Order Thinking Skills or Higer Order Thnking Skills. Analysis, evaluate, and create are three level of revised Bloom Taxonomy that represent the critical thinking skills. It can be concluded that the higher critical thinking is, the higher student achievement especially in cognitive aspect. The results show that (1) Problem- Based Learning affects critical thinking, (2) Problem-Based Learning affects student achievement in cognitive aspects, and (3) there was a significant relationship between critical thinking and student achievement. The higher critical thinking is, the higher student achievement especially cognitive aspects of the students.

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BE - 08

Relationship Between Junior High School Science Teachers' Understanding Of Inquiry Learning Based On Their Teaching Experience And School Type

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Abstract :Inquiry is the soul of science as one of the main goals of learning science, therefore every science teachers ideally with a good understanding on inquiry learning. This study aims to determine the relationship between junior high school science teachers' understanding of inquiry learning based on their teaching experience and type of school. This research is descriptive research. The population was all science teacher of Junior High School in Surakarta, sample consisted of 39 science teachers as represent from 39 of different schools (public school and private school) were taken using purpose sampling. Public school is type of school which financial and educators supported by government, private school is particular school which independent financial and educators supply. Teaching experience was classified into 4 categories: category 1 (0 until 3 years experience in teaching); category 2 (4 until 9 years experience in teaching); category 3 (10 until 14 years experience in teaching); and category 4 (15 until 30 years experience in teaching). Data collecting were using test technique to determine science teachers' understanding of inquiry learning based on their teaching experience and non-test technique by using questionnaire to find out the teachers' understanding of inquiry learning based on their school type. Data of science teachers' understanding of inquiry learning based on their teaching experience was analyzed as quantitative methods by using product moment correlation test of Karl Pearson, and data of science teachers' understanding of inquiry learning based on their school type was analyzed as qualitative methods. The results showed that: 1) There is no significant relationship between junior high school science teachers' understanding of inquiry learning based on their teaching experience (sig. 0.885> 0.05); 2) There is no significant relationship between junior high school science teachers' understanding of inquiry learning based on their school type (sig. 0.154> 0.05); 3) There is no significant relationship between teaching experience and school type (sig. 0.122> 0.05). Based on the results of this study can be concluded that there is no relationship between junior high school science teachers' understanding of inquiry learning based on their teaching experience and school type.

Keywords: *teaching experience, school type, junior high school science teachers' understanding of inquiry learning*

I. INTRODUCTION

Implementation of formal education at all levels can be held through public and private schools. Public schools organized by the government, known as public schools. However, due to the limited capacity of public schools, it can also be implemented through private schools. Although the same curriculum standards, but in practice can differ. This is because the quality of learning is influenced by several factors, one of the important factors that influence the teachers' experience in teaching. In the context of the science learning, the teacher is not only required seniority in teaching, which more important is how teachers teach the appropriate nature of science teaching which refers to three things: process, product, and attitude. The science teacher is required to encourage students to build concepts independently through inquiry. This is relevant to the purpose of learning science in recent curriculum (2013) that the inquiry be an integral part in learning science. So that science teachers' understanding of inquiry learning contributed to science learning objectives achievement successfully. All science teachers (novice and senior teachers) either taught in public and private schools should ideally have adequate ability in teaching inquiry-based science material which becomes the spirit of learning science. Based on these, the research has focused on the relationship between science teachers' understanding of inquiry learning based on their teaching experience and schools types.

II. PURPOSE OF STUDY

This study aims to determine the relationship between science teachers' understanding of inquiry learning based on their teaching experience and schools types. This aims to answer questions: 1) How the relationship between science teachers' understanding of inquiry learning based on their teaching experience; 2) How the relationship between science teachers' understanding of inquiry learning based on their school type; 3) How the relationship between teaching experience and type of school.

III. METHODOLOGY

This research is descriptive research. The population was all science teacher of Junior High School in Surakarta, sample consisted of 39 science teachers as represent from 39 of different schools were taken using purpose sampling. Data collecting were using test technique to determine science teachers' understanding of inquiry learning based on their teaching experience and non-test technique by using questionnaire to find out the teachers' understanding of inquiry learning based on their school type. Data of science teachers' understanding of inquiry learning based on their teaching experience was analyzed as quantitative methods by using product moment correlation test of Karl Pearson, and data of science teachers' understanding of inquiry learning based on their school type was analyzed as qualitative methods.

IV. RESULTS

Science teachers who were respondents in this study categorized based on his/her experience in teaching into 4 categories (X1 variable) as shown in Figure 1.

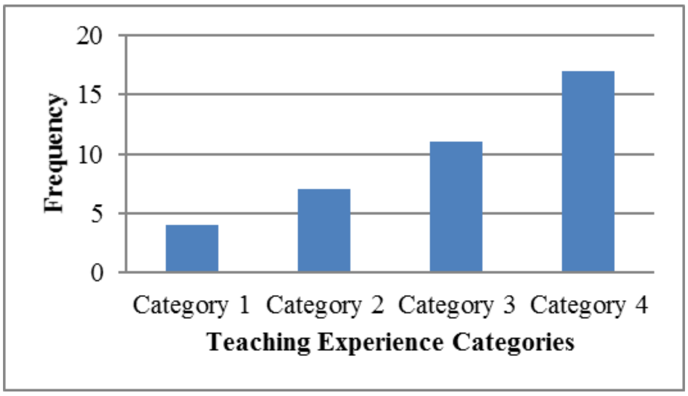


Figure 1. Teaching Experience

Figure 1 showed teaching experience category 1 (0 until 3 years experience in teaching) with frequency of 4 persons, category 2 (4 until 9 years experience in teaching) with frequency of 7 persons, category 3 (10 until 14 years experience in teaching) with frequency of 11 persons, and category 4 (15 until 30 years experience in teaching) with frequency of 17 persons.

School type categorized into 2 types as public school and private school (X2 variable) shown in Figure 2
.

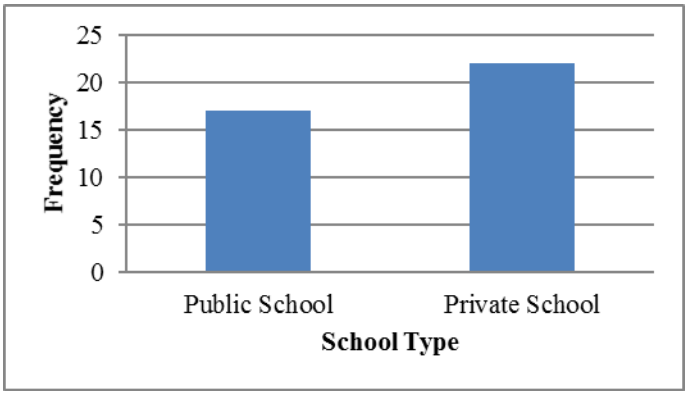
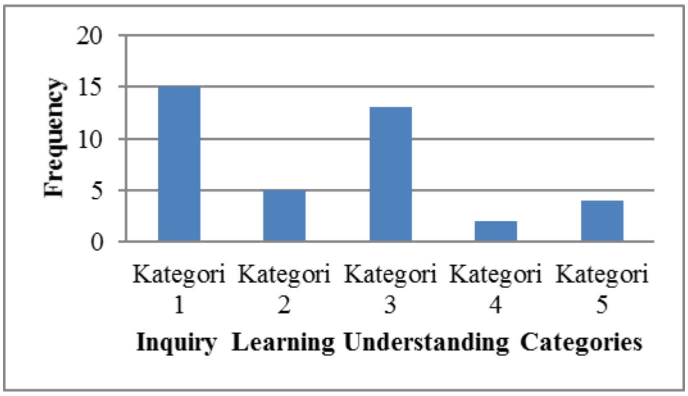


Figure 2. School Type

Figure 2 showed public school teacher with frequency of 17 persons and private school teacher with frequency of 22 persons

.

Junior high school science teachers' understanding of inquiry learning (Y variable) as shown in Figure 3.



Figture 3. Inquiry Learning Understanding of Junior High School Science Teachers

Figure 3 showed data of Junior high school science teachers' inquiry learning understanding. 15 persons with very good category (score 80), 5 persons with good category (score 75), 13 persons with moderate category (score 70), 2 persons with less category (score 65), and 4 persons with very less category (score 60).

Results of correlation product moment test of Karl Pearson shown to investigate the relationship between teaching experience and school type toward junior high school science teachers' inquiry learning understanding shown as Tabla 1.

Table 1: Descriptive Statistic of Correlation Karl Pearson Test

Variable	Correlation	Decision	Conclusion
Y with X1	0.885>0.05	no significan	no relationship
Y with X2	0.154>0.05	no significan	no relationship
X1 with X2	0.122>0.05	no signifikan	no relationship

Table 1 showed that: 1) There is no significant relationship between junior high school science teachers' understanding of inquiry learning (Y) based on their teaching experience (X1) (sig. 0.885> 0.05); 2) There is no significant relationship between junior high school science teachers' understanding of inquiry learning (Y) based on their school type (X2) (sig. 0.154> 0.05); 3) There is no significant relationship between teaching experience (X1) and school type (X2) (sig. 0.122> 0.05).

V. DISCUSSION

1) Relationship between junior high school science teachers' understanding of inquiry learning based on their teaching experience.

There is no significant relationship between junior high school science teachers' understanding of inquiry learning based on their teaching experience (sig. 0.885> 0.05). This is because although the teachers have to understand about the concept of inquiry but the teacher has not been accustomed to use in learning. Interviews showed that teachers in addition to having difficulty applying it in learning. Teachers are generally less certain whether the inquiry learning undertaken will be successful. It is relevant to Colburn (2000) stated that factually, more science teachers aren't using it in their classroom. Colburns' research showed that the most common reasons, one of its reasons confusion about the meaning of inquiry. It is supported by questioner data that: 1) correct answer (category 1) with frequency of 23%; 2) almost correct answer (category 2) with frequency of 28%; 3) inaccurate answer (category 3) with frequency of 28%,; 4) not exactly answer with frequency of 5%; 5) false answer (category 5) with frequency of 15%. It's mean that teaching experience is not assurance teachers teach refers the nature of science by using inquiry.

2) Relationship between junior high school science teachers' understanding of inquiry learning based on their school type.

There is no significant relationship between junior high school science teachers' understanding of inquiry learning based on their school type (sig. 0.154> 0.05). Following the definition in the PISA. that a private school (also known as an independent school) is a school whose affairs are under the control of a private entity. Private high school must offer the same curriculum as the public sector in order to confer provincial secondary diplomas (Frenette, M. & Chan, P.C.W, 2015). Public schools and colleges managed by provincial governments or local bodies. Private schools managed by charities/missionaries (Burki, 1986). In Indonesia, types of schools can't be used as a reference related to the quality of learning. This is because there are some private schools are more complete and sophisticated learning facilities compared to public schools. Instead there are many private schools that quality is far below public school facilities both in terms of learning and teacher competency. Iqbal, M (2012) stated that teachers in public schools are highly qualified, experienced, and have people-oriented/democratic leadership style. It may be use to the better facilities in public schools in form of resources, laboratories and trained teaching staff. On the other hand most of the head teachers in private sector are less qualified, untrained and inexperienced. They tend to be task oriented and authoritative having all decision making powers in their own hands. The other hands Liaqat (2009) found in her study that quality of teaching is better in private schools as compared to public schools and the teachers of private schools prepared lesson plans before teaching as compared to public schools. Teachers of both types of schools are fully aware about the advantages and effectiveness of teaching aids. Both types of school teachers use teaching aids. However, the teachers of private schools use more teaching aids and models comparatively (Abid, et al., 1993).

Interviews showed that the root causes of the lack of understanding about inquiry learning of science teacher not about learning science, but rather due to the difficulties of teachers in implementing inquiry learning in the classroom. Search results from answer the questionnaire revealed that the difficulties teachers are generally due to limited learning facilities related instruments lab work (56 %), difficulties in student management (33 %), misperception of teachers that inquiry learning is only suitable for children high abilities (51 %). At the end of the interview the respondents stated that the science teacher basically did not mind applying inquiry learning, but still need the guidance (79 %). The science education community has embraced no idea more widely than inquiry or inquiry-based instruction. There are several approaches of inquiry-based instruction including: structured inquiry, guided inquiry, open inquiry, and learning cycle. Inquiry-based instruction is the creation of a classroom where students are engaged in essentially open-ended, student-centered, hands-on activities (Colburn, 2000).

3) Relationship between teaching experience and school type.

There is no significant relationship between teaching experience and school type (sig. 0.122> 0.05). There are terms: "experience is the best teacher ". In the education context, experience at least influenced especially on teaching and learning process. According to Scharter (2006) teacher experience has only a small effect on student learning. While many studies have established that experienced teachers (those with less than two years of experience) are typically less effective than more senior teachers, the benefits of experience appear to level off after about five years.

VI. CONCLUSION

Based on the results of this study can be concluded that there is no relationship between junior high school science teachers' understanding of inquiry learning based on their teaching experience and school type.

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Regular Papers:

Science Education

SE – 01

Developing Integrated Science Module of Calor Theme in a Guided Inquiry Based Learning

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Abstract -The study conducted to in the feasibility of module using guided inquiry approach in junior high school. This research was a Research and Development (R&D) developed by Borg & Gall, but restricted to 7 steps. The steps include: literature study and observation, designing the research, designing instruments, validation by experts, revising instruments, preliminary field testing, revising instruments based on preliminary field testing result. The field test at Muhammadiyah Junior high school 2 Kota Yogyakarta and the subjects of the study were the student class 7. Data were collected by questionnaire. The results of the study were as follow that the developed module was generally in excellent category according to experts, teachers, and colleagues. Students respond for module was also excellent.

Keywords*: Developing, Module, Guided Inquiry*

I. INTRODUCTION

Permendiknas No.22/2006 contained science teaching stated that implemented in an integrated learning science by integrating the various fields of science studies into a single discussion, which learning was emphasized on learning SETS (science, environment, technology and society). Students are expected to have a holistic understanding of science (comprehensive) to solve problems in everyday life. To make students competent in solving the problems in everyday life, learning science inquiry should be conducted in order to develop scientific process skills and attitudes as well as communicate the results of learning as an important aspect in life skills (life skills).

The stages of the learning process based on guided inquiry by Kuhlthau [1] there are seven (7) stages. The stages are initiation phase (beginning), selection (election), exploration (investigation), formulation, collection (collection / incorporation), presentation, and assessment. The stages of the learning process will have an impact on the cognitive, affective and physical ability of student. Those were according to research whose conducted by Bilgin [2], that concern about guided inquiry learning method can effectively improve the scientific attitude in students.

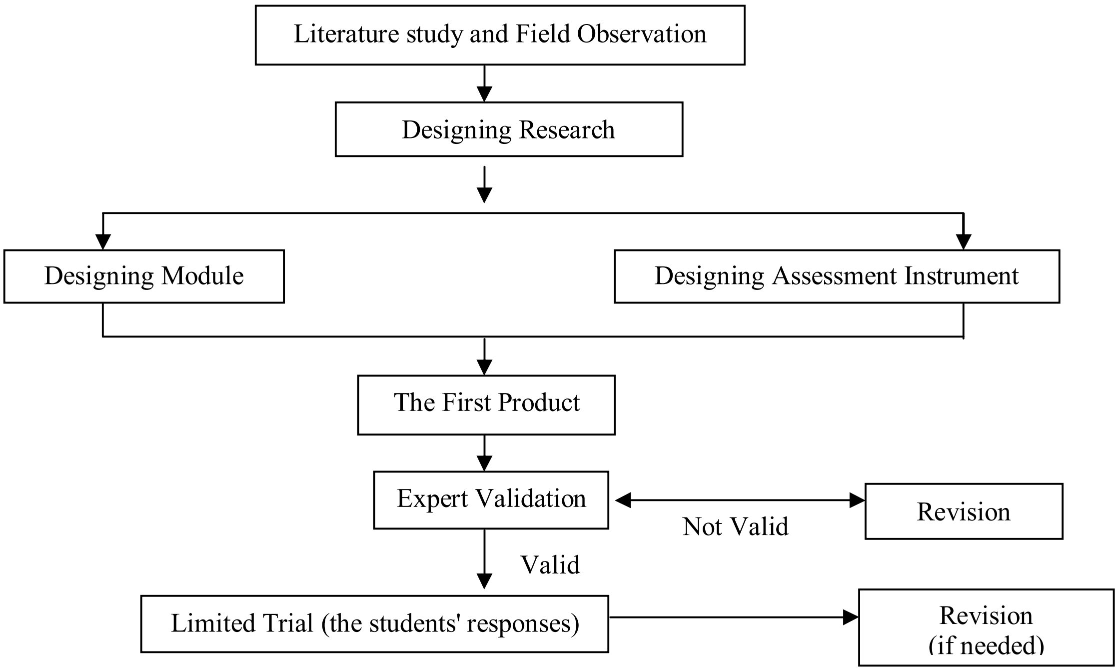
Achieving science teaching objective, government need an appropriate teaching materials. Modules, rated by Endah [3] using an inquiry-based learning effectitively to improve student achievement. In accordance with Vembrianto [4], using module were better to the traditional or classical classroom teaching where teaching is given to students of the class together. These advantages are could more motivating students to achieve the learning objectives, provide an opportunity for students appropriate to their abilities, students become more active in learning, students can apply their knowledge in real life, students acquire repetitive information about their learning progress, and teachers get instructions for the most efficient learning methods.

Todays, the problems that arise in education related to science learning, it has not been discovered a number of modular learning media based guided inquiry. Most teachers only use textbooks in the learning process, whereas most of the material in textbooks has not emphasized the achievement of the four dimensions of science. It conducted the student achievement is not optimal because it only emphasizes the aspects of cognitive or science products. Under these conditions, the researchers conducted a research entitled Development of Integrated Science Module of Calor In Guided Inquiry Based Learning.

II. RESEARCH METHOD

This research aimed at the development model using methods developed by Borg & Gall, but was restricted to 7 steps. The product developed is a module -based guided inquiry learning science for class VII with the theme of

Temperature and Calor. The development procedure adapted from Borg & Gall development steps are as follows [5]



The research instruments used comprise module evaluation sheets and students' responses questionnaire. The data were analyzed by these following steps :
1) Tabulation of data obtained for each aspect provided in the instrument.
2) Calculate the average total score of every aspect using the formula.
3) Change the average scores into grades by category from Directorate of High School [6]

TABEL 1. CONVERSION ACTUAL SCORE BEING FOUR VALUE SCALE

No	Range Of Score	Value	Category
1	Mi + 1,5 SDi≤ M ≤ Mi + 3,0 Sdi	A	Excellent
2	Mi + 0 SDi≤ M < Mi + 1,5 Sdi	B	Good
3	Mi - 1,5 SDi≤ M < Mi + 0 Sdi	C	Reasonably Good
4	Mi - 3 SDi≤ M < Mi – 1,5 Sdi	D	Less Good

III. THE RESEARCH RESULT AND EXPLAINATION

The result of this research was detailed as follows:

1. *Literature Review and Field Observation*

   The literature study done by seeking information from various sources about the problems in science learning. Field observations conducted to obtain information about the conditions that actually happened. Field observations conducted in SMP Muhammadiyah 2 Yogyakarta through interview to science educators at the school. The information obtained was, science learning process in SMP Muhammadiyah 2 Yogyakarta have not been integrated, it was still fragmented between physics, biology and chemistry. Integrated science teaching modules are not yet available. During this time, the learning method used by teachers mostly using the lecture method, yet another optimize learning methods.

2. *Design Research*

   Research model designed based on the problems that arise in literature studies and field observation at SMP Muhammadiyah 2 Yogyakarta. Based on the results of these interviews, the researchers determine to conduct research and development by developing learning media in the form of integrated science teaching modules based guided inquiry. The results of core and basic competence analysis in science teaching second semesters class VII student, the researcher determine the module that could increase literacy and scientific attitude of students on the theme of calor.

3. *Development Instrument (Science Module and Measurement)*

The instrument was developed in the form of modules guided inquiry-based science learning on the theme of calor for junior high school students class VII. In addition, researcher also make learning lesson plans, module feasibility assessment instrument, and student responses questionnaire of the developed module.

a. *Development Module*

Integrated Science Module arranged referring to core competencies, basic competencies, and syllabus materials of the calor on the curriculum in 2013 on which guided inquiry approach. The contents of the module are: title, introduction, instructions for using module, concept maps, the section title (4 section/unit), learning objectives in each unit, student activities, material/related references, keywords, worksheets, answer keys of worksheets, evaluation sheet per unit, answer key of evaluation sheet per unit, sheet of remedy for students who have not reached the expected value, answer key of remedial sheet, enrichment sheet for students who have reached the expected value.

b. *RPP (Lesson Plan)*

The lesson plan arranged refers to the syntax of guided inquiry learning approach.

c. *Module Feasibility Assessment Instrument*

Module feasibility assessment instrument developed to determine whether the developed modules was appropriate both in terms of components and content/material module. Feasibility assessment is carried out by experts (professors), teachers and colleagues.

d. *Students Assessment Instrument for Developed Module*

Students assessment instrument for developed module was in the form of a questionnaire with 14 questions using a Likert scale on score of 4-3-2-1 (SS, S, TS, STS), which more emphasizes on the aspects of legibility and learners success in the learning process using the module. The instrument must be validated by a validator expert (lecturer) before given to the students.

4. *Expert Validation*

Experts validation conducted after the completion of initial developed draft. Validator experts in this study consist of two lecturers Postgraduate UNY. Assessment of the module is also carried out by two science teachers to determine the feasibility of modules.

Data of product feasibility in the form of an assessment of the experts validator, science teachers and colleagues on scale of 1-4. The data converted into a scale of four, namely A (Excellent), B (Good), C (Reasonably good), D (less good). Here is the conversion of the assessment scores with the results of the feasibility module,

TABLE 2. CONVERSION SCORE RATING SCALE FOUR ON MODULE

Aspect	Interval Skor	Value	Category
Module Element	$35,72 \leq M \leq 43,93$	A	Excellent
	$27,50 \leq M < 35,72$	B	Good
	$19,28 \leq M < 27,50$	C	Reasonably Good
	$11,07 \leq M < 19,28$	D	Less Good
Content Element	$45,46 \leq M \leq 55,92$	A	Excellent
	$35,00 \leq M < 45,46$	B	Good
	$24,54 \leq M < 35,00$	C	Reasonably Good
	$14,08 \leq M < 24,54$	D	Less Good

Results of the assessment of the developed module by validator is as follows ,

TABLE 3. MODULE ELIGIBILITY RESULT DATA BY EXPERT

No	Aspect	Skor	Category
1.	Module Element	40	Excellent
2.	Content Element	51	Excellent

TABEL 4. MODULE ASSESSMENT BY SCIENCE TEACHERS

No	Aspect	Skor	Category
1.	Module Element	41,50	Excellent
2.	Content Element	52,50	Excellent

Based on the results of the assessment by the validator, the module overall gets excellent category with an A, so that the module is suitable for use in learning after the revisions based on suggestions and feedback from the assessors.

5. *Revisions Validator*

Module revised first phase, improvements were on the following matters:

a. Introduction/general guidelines laid out in the beginning in order to facilitate the students using the module.
b. Replace the word "why" on a worksheet into a "how to" in order to discover profound answers.
c. Beautify module layout to entice student interest.

6. *Limited Field Test*

Limited field test conducted to determine students' response on developed modules. This limited test conducted at SMP Muhammadiyah 2 Yogyakarta in Class VII H which randomly selected due regard to the ability of learners is the ability of high, medium and low. After completion of the learning process using the developed module, the students were given a questionnaire to perceive the students' responses of developed module, as well as feedback or suggestions for improvements.

Data by questionnaire have been tabulated with a scale of 1-4 and converted into score rating. These students' responses data could be seen below.

TABLE 5. CONVERSION SCORE RATING SCALE QUESTIONNAIRE RESPONSE OF STUDENTS

Aspect	Interval Skor	Value	Category
Learning Objective	$12{,}98 \leq M \leq 15{,}98$	A	Excellent
	$10{,}00 \leq M < 12{,}98$	B	Good
	$7{,}01 \leq M < 10{,}00$	C	Reasonably Good
	$4{,}02 \leq M < 7{,}01$	D	Less Good
Conditions of use module	$9{,}74 \leq M \leq 11{,}98$	A	Excellent
	$7{,}50 \leq M < 9{,}74$	B	Good
	$5{,}26 \leq M < 7{,}50$	C	Reasonably Good
	$3{,}02 \leq M < 5{,}26$	D	Less Good
Learning Time	$3{,}25 \leq M \leq 3{,}99$	A	Excellent
	$2{,}50 \leq M < 3{,}25$	B	Good
	$1{,}75 \leq M < 2{,}50$	C	Reasonably Good
	$1{,}01 \leq M < 1{,}75$	D	Less Good
Language and Graphics	$19{,}48 \leq M \leq 23{,}96$	A	Verry Good
	$15{,}00 \leq M < 19{,}48$	B	Good
	$10{,}52 \leq M < 15{,}00$	C	Reasonably Good
	$6{,}04 \leq M < 10{,}52$	D	Less Good

The results of students' response to science learning module on limited field testing is as follows,

TABLE 6. DATA RESULTS STUDENT RESPONSE OF THE MODULE

No	Aspects of Assessment	Score	Category
1.	Learning Objective	14,10	
2.	Conditions of use module	10,00	
3.	Learning Time	3,70	
4.	Language and Graphics	20,10	

Based on limited field test results, for entirety aspects of assessment, students stated that the module gets excellent with grades A. Module was feasible used for expanded field test.

7. *Revision of Field Test Limited*

Beside providing an assessment, the students also gave suggestions for refinement the module so that it can be used in expanded field test. In the second stage revision, some refinements made at the following points:

a. Separation module components into twoparts, one module contains learning activities with worksheets, while the second module contains the answers key of all questions in the module. This was done so that students attempted more optimal to find the answers themselves .

b. Fix some spelling errors on the module .

IV. CLOSING

Based on the results of the research, it can be concluded that the developed module stated feasible to use in learning and have an excellent quality based on expert validator and a science teacher assessment. Students' responses to the module were also included in an excellent category. With considered feasible, it was essential to further research to improve these products.

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SE – 02

Improving Students' Entrepreneurial Attitude Through Local Potential Pottery and Furniture of Jepara

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Abstract**—**This research aims to analyzing the effectiveness of science teaching based on local potential pottery and furniture of Jepara to improve students' entrepreneurial attitude of SMPN 1 Bangsri Jepara. The mothods of this research is quasi-experiment with the cluster random sampling and pretest-posttest control group design. The instruments is entrepreneurial attitude questionnaire which has been valid by the expert, teacher, and peers validation. This research held by an activity in science learning that makes students and entrepreneurs can interact each other directly. Jepara's pottery and furniture are some example of home industry also some of local potential in Jepara that related to science subject, especially in VIII grade of SMP. Entrepreneurial ability is needed to commemorate ASEAN economic community in the future of 21st century. This learning activity expected improve students' entrepreneurial attitude in the 21st century. The results of the research is science teaching based on Jepara's local potential effective to improve students' entrepreneurial attitude of SMPN 1 Bangsri Jepara. The effectiveness of science teaching obtained from t test. The Result of t test on entrepreneurial attitude shows at sig. 0,000. It's mean science teaching based on local potential pottery and furniture of Jepara effective to improve students' entrepreneurial attitude of SMPN 1 Bangsri Jepara.

Keywords: *science teaching, local potential, entrepreneurial attitude*

I. INTRODUCTION

Many potential areas in Indonesia, including local potential relating to the cultural and entrepreneurial world (home industry). Parmin, Sajidan, Ashadi, & Sutikno revealed that "Indonesian society has a variety of traditions, habits, and values of life that has been used for generations as a guide, which in the past has proven capable of maintaining the environmental balance" [*1*]. Potential local is an activity in community and industry in a local or regional. Mumpuni states that local potential is the potential of an area includes the potential of natural sources, the potential of human resources, geographic, cultural, and historical [*2*]. Meanwhile, Kanzunnudin & Oktavianti mention that the benefits of local (local potential) is everything that characterizes regionalism include agricultural products, the creation of art, tradition, culture, care, services, natural resources, human resources, or others who become the advantage of an area [*3*].

Local potentials need to be explored and exploited in supporting the teaching process. Exploitation of the region potential (local potential) can be done by involving local potential in developing the teaching kit, so that teaching process makes students easier to understand the material by interacting directly with the source of teaching materials. It is according with the opinion of Alexon which states that education should involve a variety of significant local potentials to the needs of the community so the school is not estranged from the community and local culture [*4*]. The involvement of local potential is expected to make the students to be more creative and flexible in exploring all relevant information in depth learning materials. Students are also easier to understand the existence and benefits of local potentials in the surrounding area, so it can improve the entrepreneurial attitude of students. In the Regulation Ministry of Education and Culture, No.103 of 2014 in Primary and Secondary Education, the Education Minister said that "Teaching is a process of interaction between all students and between students with teachers and learning resources in a learning environment" [*5*]. Learning sources can be obtained by utilizing local potentials around the school that can be formed as a teaching kit.

Each region has a specific location causing local potential differences respectively. Jepara is one of regencies in Central Java province has a lot of local potential in several districts, including industrial manufacture of pottery in Mayong district, industry Furniture in Mlonggo district, industrial Monel in Kalinyamatan district, Troso Weaving industry in Pecangaan district, and industrial manufacturing of bricks in Welahan district. The existence of Jepara regency in Central Java province has a lot of local potential can be utilized and integrated into the learning process of science education at all levels, including at the junior level. Especially science materials on the 2013 curriculum of the junior high school. Local potentials are related to people's livelihood around. The majority Jepara livelihoods in agriculture, manufacturing, services and trade are scattered in various districts in Jepara regency. Processing industry which is meant them in the form of furniture (wood processing), convection, weaving, and various craft industries [*6*].

Local potentials in Jepara regency are including convection center in Sendang village Kalinyamatan districts, Troso weaving industry located in Troso village Pecangaan district, Monel handicraft in Kriyan village Kalinyamatan districts, and centers of rubber plants in Kembang district. Mlonggo district is one of the districts in Jepara regency that became an industrial area in the other district of Jepara furniture than the Tahunan districts, both small and large scale. In addition, there are centers of handicrafts made of clay which are in Mayong district which is an area of making pottery and in Welahan district which is a center for the manufacture of bricks, but in this study will focus on making pottery in Mayong district and industry of furniture in the Mlonggo district.

Local potential of manufacturing pottery (earthenware of jug or *kendi* in Javanese) in Mayong district started from the utilization of natural resources in the form of clay as basic materials. Clay used for the manufacturing of pottery are processed through several stages (Figure 1). The stages in manufacturing of pottery at least consist of soil acquisition, preparation of the soil so that the soil becomes clay and smooth, the formation of pottery using swivel traditional techniques in two steps, namely the manufacture of the *borong* (body of jug) and *gucu* (neck of jug) which is then affixed, drying process using room temperature, burning process with gradual warming to temperatures 1200^{O}C, and improvement (finishing). Finishing earthenware of jug by coloring is done during the process of reduction of the furnace when the condition is still smoldering. Earthenware of jug coloring is done using bran (*bekatul*) sprinkled and burned (*dibrongot* in Javanese) on the outer wall of the pottery (earthenware of jug).

FIGURE 1. PROCESS OF MANUFACTURING POTTERY (EARTHENWARE OF JUG)

Local potential furniture of Jepara is an industry that requires a wood as base materials to be processed into various products mebelair in the household, such as tables, chairs, cabinets, beds, and some trinkets souvenirs from wood. The type of wood must be adjusted to the goals and needs, as well as the type of product to be produced. The wood from the different trees have different characteristic, so its use is also different. The wood characteristics that must be considered before the forming process into products mebelair are density, durability, hardness, color, texture, the value of decorative, the impression of touch, smell, and taste.

Some stages of wood manufacturing process in furniture industry of Jepara as shown in Figure 2 are:

a. The preparation stage: the selection of good wood material for the manufacture of furniture.
b. The drying stage: drying the wood by using sunlight.
c. Forming stage of part of the furniture: the wood is cut or sawn formed the parts of furniture to be made.
d. Smoothing stage (the first sanding stage): each piece of furniture smoothed with sandpaper way
e. Glueing stage: each piece of furniture to be assembled furniture raw product
f. The second sanding stage: raw furniture grinded again until completely smooth and ready to be painted or colored furniture.
g. Finishing stage: raw refined furniture, painted or polished up to be the final furniture products.

FIGURE 2. STAGES OF MANUFACTURING FURNITURE OF JEPARA

The development of science, technology, and information of 21st century has brought changes in all aspects of life, including in the industry and economy that requires readiness of related resources. As one of the country members of ASEAN (Association of South East Asian Nations), Indonesia is appropriately prepared all resources to commemorate AEC (ASEAN Economic Community). Human resources that qualified and characterized as a potential successor to the nation is expected to compete in the ASEAN economic community in the 21st century.

Efforts to prepare the next generation that qualified and characterized are being implemented by Indonesia to improve the quality of Indonesian human resources. This effort can be reached through education in a teaching process to commemorate of the science and technology development in the 21st century. It is consistent to the statement of the President of the Republic of Indonesia in Law No. 20 Year 2003 on National Education System, Chapter II, Verse 3 [*7*] that:

> National Education serves to develop the ability and character development and civilization of the nation's dignity in the context of the intellectual life of the nation, aims to develop students' potentials to make faith and devoted person to Almighty God, noble, healthy, knowledgeable, skilled, creative, independent and become citizens of a democratic and accountable.

Natural science as part of the educational system uses a scientific approach and contextual knowledge in teaching process to create more meaningful learning. Meaningful learning in teaching process should be oriented to engage students as maximal as possible in each of the activities [*4*]. This meaningful learning will be felt as during the preparation of learning is done by considering the needs and involvement of students maximally.

There are many learning materials which can exploit the potential of the local environment around the school, including in the science teaching. Science should be seen as a way of thinking for the purpose of understanding the nature, as a way of investigation to declare the phenomena, and as a body of knowledge as the results of inquiry [*8*]. In science teaching process, emphasis granting direct experience to develop skills that students are able to explore and understand the universe around (the local potential) scientifically by seeking out and do or interact directly. This helps students to gain deeper experience of the surrounding nature of facts, concepts, principles, laws of nature, models, and theories that form the knowledge. This depth of experience that will be obtained students to engage in science-based learning environment (local potential).

Entrepreneurial attitude is an attitude related to the interest in entrepreneurial or do business to earn income. Entrepreneurship is a dynamic process to create additional prosperity. This additional wealth created by the entrepreneurs who bear the risk, spending the time and provides a variety of products or services [*9*]. Hisrich, Peters, & Shepherd [*10*] reveals that "… there are some common aspects: risk taking, creativity, independence, and rewadrs. This commonalities will continue to be the driving force behind the notion of entrepreneurship in the future.*"* .

Fan, Zhang, & Qiu [*11*] state that need combine between entrepreneurial and education from entrepreurs directly. Social interaction between students and entrepreneurs can improve the entrepreneurial skill of students

[12]. Lupiyoadi [13] also state that "... *mitos entrepreneur is born tidak berlaku, karena pada realitasnya kewirausahaan dapat dibentuk melalui proses belajar*". Its mean that entrepreneurial attitude need to be learn as habitual.

The value of entrepreneurship can be developed on the students through the teaching process at schools to improve the entrepreneurial attitude of students. Enterpreneurship was originally only developed in the field of trade, but over the times, pursued expansion into other fields such as industry, healthcare, government, education, and community organizations. Ministry of National Education [14] revealed that the development of academic texts have some entrepreneurial values that are considered most appropriate for the level of development of students. There are 17 values (attitude) of entrepreneurship were developed by educational units gradually, they are: independence, creative, risk-taking, action-oriented, leadership, hard work, honesty, discipline, innovation, responsibility, cooperation, never give up (tough), commitment and curiosity, realistic, communicative, and has a strong motivation to succeed.

Entrepreneurial attitude is the nature and value of someone to do entrepreneurship both in industry and society. Appropriate to the development stage of students in junior high school is necessary to develop an entrepreneurial attitude through a teaching process based on local potentials on four aspects of entrepreneurial attitudes, they are: independent, creative, honest, and hard work.

Based on the description above, researchers need to analyze the effectiveness of science teaching based on local potential pottery and furniture of Jepara to improve the entrepreneurial attitude of SMPN 1 Bangsri Jepara's students.

II. METHODS

This research is a quasi eksperimen. The research was held in Jepara regency, precisely at SMPN 1 Bangsri in the academic year 2015/2016 the 1st semester.

The subjects were VIII grade students of SMPN 1 Bangsri Jepara regency in the academic year 2015/2016 the 1st semester. This school is one of the schools that have been use the 2013 curriculum, in Jepara regency. Population of this research was all VIII grade students of SMPN 1 Bangsri Jepara regency. Samples are drawn by random cluster sampling from 9 classes, and obtained class VIII C as the experimental group and class VIII B as the control group.

This research was held using a quasi-experimental with class VIII B and VIII C as the experimental group and control group. The design of this research in quasi-experimental research is pretest-posttest control group design as shown in Figure 3. Students in the experimental group and control group given pretest and posttest for questionnaire of entrepreneurial attitude before and after treatment.

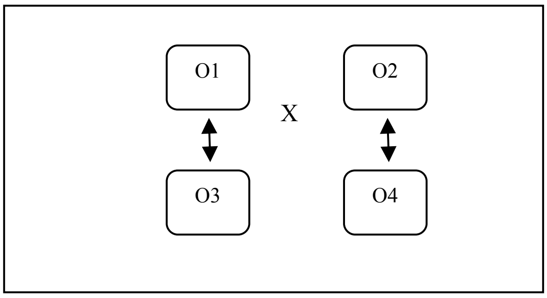

FIGURE 3. PRETEST-POSTTEST CONTROL GROUP DESIGN [15]

Information:
O1: pretest of the experimental group
O2: posttest of the experimental group
O3: pretest of the control group
O4: posttest of control group

Teachers implement instructional by the teaching kit based local potential of manufacturing pottery and furniture from Jepara to the experimental group, while the control group teachers implement instructional by the teaching kit are used to be

A. Data, Instruments and Data Collection Techniques

The data in this research were obtained using non-test evaluation techniques such interview guideline sheet using when the initial study, a questionnaire for the assessment of entrepreneurial attitudes and observation sheet for observation of teaching implementation. Data from interviews at the preliminary study stage is used to determine the needs and field conditions. The results of the data were described as the basis of this research.

Entrepreneurial attitudes were measured using a questionnaire of entrepreneurial attitude that consists of 15 items which has been valid by the materials expert, media expert, science teacher, and peers validation. The questionnaire of entrepreneurial attitude was used to measure the entrepreneurial attitude of students. The observations of teaching implementation were done by using observation sheet of teaching implementation. The observations were done to measure percentage of teaching implementation using teaching kit based on local potential pottery and furniture from Jepara. The observations were done by two observers (observer) each of the teaching process.

B. Data Analysis Technique

Data of pretest and posttest that have been obtained during the research, calculated the score of standard gain before analysis process. Data of gain standards obtained using the Gain Standards technique [*16*]. Equation for this technique is:

$$Gain\ Standard \quad \frac{skor\ posttest - skor\ pretest}{skor\ maksimum - skor\ pretest}$$

Gain score which has been obtained can be categorized in the category of low, medium, or high. [*17*] describes a category gain the following standards:

$\langle g \rangle \geq 0,7$	: high gain
$0,3 \leq \langle g \rangle < 0,7$	: medium gain
$\langle g \rangle < 0,3$	: low gain

There are two analysis processes, thea are analysis of teaching implementation using the teaching kit based on local potential and effectiveness analysis of science teaching using the tesching kit based on potential local pottery and furniture Jepara to improve students' the entrepreneurial attitude.

At each meeting using the teaching kit based on local potential of pottery and furniture from Jepara, assessed using a questionnaire sheet of teaching implementation by two observers, so that each obtained a total score. The teaching implementation using teaching kit based on local potential assessed from the implementation of each item in the observation sheet. Number of items divided by total grain accomplished so teaching implementation score obtained in a percentage. To determining the percentage of teaching implementation each observer using the following equation.

$$of\ Teaching\ Implementation \quad \frac{Total\ of\ teaching\ step\ on\ lesson\ plan\ implemented}{Total\ of\ teaching\ steps\ on\ lesson\ plan}x$$

Implementation of the teaching kit based on local potential in learning observations by two observers catagorized be good if ≥ 0.75, or 75% [*18*]. To determine the percent of agreement on the implementation of the lesson plan using the following equation.

$$Percentage\ of\ agreement = 100\%\ [\ -\frac{A-B}{A+B}]$$

Information:
A = Rate of observer 1 (which gives high value)
B = Rate of observer 2 (which gives low value) [*18*].

The t test on the data entrepreneurial attitudes of students use to determine the effectiveness of teaching process based on local potential pottery and furniture from Jepara.

The t test statistic requires two assumptions that must be done first, the normal distribution of data and the data must from a homogeneous population univariate. Assuming the test is performed on a standard score gain the entrepreneurial attitude of students using SPSS 22 on α significance level of 5%

Normality test were have been performed on data standard gain scores calculated with the following hypotheses.

$_0$: Data derived from normal distributed population.

$_a$: Data come from populations that are not normally distributed.

The normality test is done on each of the experimental group and control group. Normality test is done using SPSS 22 *Shapiro Wilks* at 5% significance level α. Criteria for normality test at 5% significance level α is the data comes from populations with normal distribution or $_0$ accepted if the significance value is greater than the value of α (sig.> α).

The next assumption is homogeneity test. Homogeneity test is performed to determine whether the samples homogeneous population or not.

$_0$ Both population samples are equal or homogeneous.

$_a$ Both population samples are not equal or not homogeneous..

The homogeneity test is done by using SPSS 22 *Levene's Test* at the 5% significance level α. Criteria for test of homogeneity of the significance level α 5% is the second population is otherwise the same sample or homogeneous or $_0$ accepted if the significance value is greater than the value of α (sig.> α).

After the second test of the above assumptions are met, t test must be done to determine the effectiveness the science teaching based on local potential pottery and furniture of Jepara to improve students' entrepreneurial attitude. Here are t test hypothesis.

H_0: science teaching kit based on local potential Jepara is not effective than teaching kit commonly used to improve the entrepreneurial attitude of students

H_a: science teaching kit based on local potential Jepara effective than teaching kit commonly used to improve the entrepreneurial attitude of students

The t tests were performed on significance level α 5% with SPSS 22. Criteria for acceptance or rejection of H_0 at siginficance level α 5% are:

a. H_0 is rejected if sig. < α.

b. H_0 is accepted if $sig \quad \alpha$.

III. Result and Discussion

This research was held in three times meeting of teaching process. The students in experimental group are given the science worksheet based on local potential pottery and furniture of Jepara to guide learning activity. Meanwhile, the students of the control group using science worksheet like used to be. During the teaching process, there are two observers who observe teaching implementation using lesson plan based on local potential pottery and furniture of Jepara. The data were analyzed as presented in Table 1.

TABLE 1. Summary of Analysis Observations of Teaching Implementation

No	Meeting	Observer	Total of Implemented Teaching Step	% of Implementation	% of Agreement	Criteria
1	1	1	15	83,33	96,55	Good
		2	14	77,78		
2	2	1	16	88,89	96,97	
		2	17	94,44		
3	3	1	17	94,44	96,97	
		2	16	88,89		

Based on Table 1, at each meeting of learning using lesson plans based on local potential pottery and furniture of Jepara lead to the conclusion percentage of agreement is over than 75%. According to the provisions, if the percentage of agreement over than 75%, then the criteria of teaching implementation of the lesson plan is good. Students are also very enthusiastic in following the teaching, learning both in the classroom (laboratory) and learning outside the classroom during a visit to the manufature of pottery in Mayong district and manufacture of furniture in Mlonggo district.

The students of two group are given a questionnaire of entrepreneurial attitude before and after treatment. Based on data from the pretest score, posttest score, and standard score gain of entrepreneurial attitudes, can be summarized some data description required. Data description of pretest, posttest score, and standard score gain of entrepreneurial attitudes of students in the experimental group and control group is presented in Table 2.

TABLE 2. SUMMARY OF ENTREPRENEURIAL ATTITUDE MEASUREMENT RESULT

No	Component	Experimental Group			Control Group		
		Pretest	**Postest**	**<g>**	**Pretest**	**Postest**	**<g>**
1.	Total of Subject	40	40	40	39	39	39
2.	Maximum Score	90	97	0,90	88	93	0,53
3.	Minimum Score	60	77	0,35	60	69	0,07
4.	Average	74,85	89,88	0,59	73,74	81,64	0,30

Information: <g> : gain standard

Based on Table 2, analysis on the average score of the standard gain (<g>) that obtain the average value of the standard gain entrepreneurial attitude in the experimental group of 0.59 and 0.30 in the control group. The average gain is standard on the experimental group and control group each middle category, but still showed improvement scores entrepreneurial attitudes students experimental group higher than the control group students. This improvement was possible by the interaction of students with the craftsmen of pottery and furniture that makes the entrepreneurial attitude that has been owned students become more excavated.

Comparison charts the average score of pretest and posttest entrepreneurial attitudes between the experimental group and control group is presented in Figure 4.

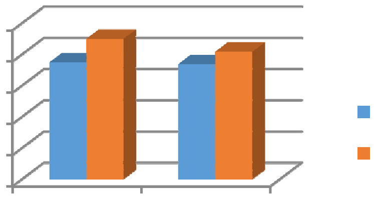

FIGURE 4. COMPARISON OF THE AVERAGE OF PRETEST AND POSTTEST OF ENTREPRENEURIAL ATTITUDE BETWEEN THE EXPERIMENTAL GROUP AND CONTROL GROUP

Based on an average, standard gain scores in the experimental group is higher than the control group. As a comparison chart average achieved a standard score gain between the experimental group and control group is presented in Figure 5.

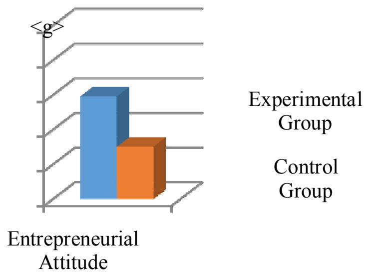

FIGURE 5. COMPARISON STANDASD GAIN SCORE OF STUDENTS' ENTREPRENEURIAL ATTITUDE IN FIELD TESTING BETWEEN THE EXPERIMENTAL GROUP AND CONTROL GROUP

The univariate normality test of *Shapiro-Wilk* was done on each group of experimental and control using SPSS 22. Based on the analysis of data normality test showed that the data came from a normal distributed population or H_0 accepted by sig.> α at significance level5%. Normality test results are presented in Table 3.

TABLE 3. RESULT OF UNIVARIATE NORMALITY TEST *SAPHIRO-WILK*

No.	Variable	Experimental Group		Control Group	
		Sig.	**Decision**	**Sig**	**Decision**
1.	Entrepreneurial Attitude	0,229	H_0 accepted	0,814	H_0 accepted

The homogeneity test Levene's Test was performed using SPSS 22. The homogeneity of the data can be concluded that the sample data came from a homogenous population if H_0 is accepted by the sig.> α at significance level 5%. The test results show the homogeneity of the sample data comes from a homogeneous population. Univariate homogeneity test results are presented in Table 4 below.

TABLE 4. RESULT OF HOMOGENEITY TEST (LEVENE'S TEST)

No.	Variable	Sig	Decision
1.	Entrepreneurial Attitude	0,329	H_0 accepted

Univariate normality test of the entrepreneurial attitude variable found that the data came from a normal distributed population. Levene's test of homogeneity test has been done also lead to the conclusion samples come from a homogeneous population, thereby t test on the entrepreneurial attitude variable to determine differences in the effectiveness of the use of the science teaching kit based on local potential Jepara as a result of the development. The effectiveness of the use of the science teaching kit based on local potential pottery and furniture of Jepara as a result of the development compared to the commonly used learning science teacher can be seen from the gain on the differences between the mean scores of each group of treatment to improve students' entrepreneurial attitude. The results of t test on the entrepreneurial attitude variable is presented in Table 5.

TABLE 5. RESULT OF THE T TEST ON ENTREPRENEURIAL ATTITUDE

No.	Variable	t	Average of <g>		Sig	Decision
			Experimental Group	Control Group		
1.	Entrepreneurial Attitude	10,199	0,25	0,30	0,000	H_0 rejected

Based on the result of t test in Table 5, it can be concluded that the science teaching based on local potential pottery and furniture of Jepara effective than science teaching that commonly used to improve the entrepreneurial attitude of students. This research according to the research before by Sarah & Maryono that the utilization of local potential in learning process improve the students' living values [*19*]. This is possible because a visit to the local potential of manufacturing pottery in Mayong district and furniture of Jepara in Mlonggo district as part of the science teaching process makes students learn actively and interactively directly to the craftsmen. It is according to Alexon's statement that involvement of local potential to the activities in teaching process gives the student a meaningful learning. The involvement of local potential as it also makes learning more contextual and meaningful and provide a deep understanding. These learning process also give a direct example of living values in entrepreneurship so as to improve the entrepreneurial attitude of students as the future generation in ASEAN economic community of 21st century.

IV. CONCLUSION AND SUGGESTION

A. Conclusion

Based on the analysis that has been done, it can be concluded that the science teaching based on local potential pottery and furniture of Jepara effectives to improve students' entrepreneurial attitude SMPN 1 Bangsri Jepara.

B. Suggestion

Based on the research that has been done, the suggestion that can be given is:

1. Science teacher of SMP in Jepara regency should be able to exploit the local potential pottery and furniture of Jepara around the school into learning activity, so that students can learn a contextual and meaningful about the matter directly with entrepreneurs as the appropriate learning resources.
2. Learning science based on local potential pottery and furniture of Jepara is expected to be an example for teachers in making science teaching kit which involves local potential around the school.
3. For areas with different characteristics of local potential, teachers can modify the local potential to be integrated in the learning process according to the conditions.

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SE – 03

Practicality of Cognitive Style-Based Learning Strategy for Developing Science Problem Solving Ability of Elementary Students

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Abstract—This study is part of the research and development of cognitive style-based learning strategy for developing problem solving ability of elementary students. Practicality of the learning strategy, which is realistic usability to be applied in the learning process of conductor-insulator and material change, was investigated. It was measured by observation of learning process, and questionnaire/interview of both teachers and students. This research showed that the learning strategy is practice for developing the science problem solving ability of elementary students: experts and practitioners judge that that the strategy developed can be applied in the class with validation score is exelence category; the usabilty of learning strategy, relationship between it elements and it characteristics is exelence category, respectively. The students perform a good learning activity along the science class. Generally, teachers as well as students did not have obstacles, significanly in applying the learning strategy in elementary science class. Although, the field independent (FI) student tend to give more positive response than the field dependent (FD) one. This finding will lead to a supporting to the implementation of national science curriculum.

Keywords: *learning strategy, science, cognitive style, field dependent, field independent, problem solving*

I. INTRODUCTION

Problem solving is one of the 21st century skills that have to be practiced to the students since they are in the childhood in order to prepare their future. They may be organized into four group, each comprising three to four competencies [1]: thinking includes creativity, critical thinking, problem solving and metacognition; working involves communication and collaboration; information and technology literacies are the tools for working; citizenship, life skills, and personal responsibility are necessary for living in the word.

Problem solving requires a set of knowledge that must be possessed by the students as factual, conceptual and procedural knowledge [2]. Thus, the more relevant knowledge, the better their ability to solve the problems encountered. When students experience learning through the problem solving, students have more potential in creating the optional ways to solve the problem, developing new understanding, and increasing their ability to understand the problem in depth [3].

Childhood, especially 6-11 years old, is the important phase for developing students' problem solving ability. Elementary students (6-11 years old) have the concrete operational stage of cognitive development [4]. According to [5] the elementary school students of Banjarmasin generally have the concrete reasoning ability and few of them have the transition reasoning ability and beginning of formal reasoning. Mean while, most of them have the field dependent cognitive style, although there is a significant number, 33% of field independent cognitive styles. In this stage, they are rooted deeply in their environment and have difficulty with abstract thinking. As expressed by [6], they able to construct a concepts to see a relationships and even to solve a problems, if they involve a real object or known situation.

In order to develope problem-solving ability of elementary school students, the problem-solving-based learning strategy must be able to accomodate cognitive development of students. At the concrete operational stage, student will be able to think logically if these thinking can be applied to authentic or concrete examples [7]. According to Nur (2011), students in this concrete operations stage can draw conclusions based on the concrete experience gained through their senses (empirical inductive reasoning). Learning should also provide a funny environment, e.g by implementing game which appropriate to students' characteristics. It's will lead students to well perform accommodation and assimilation of knowledge.

Other students characteristic that have to be concider for developing problem-solving ability is cognitive style. Cognitive development related to one's readiness and ability to perform a certain development tasks including learning, while cognitive style refers to a person's preferred way to process information. According to [9], "Cognitive styles refer to differences in people's preferred way of processing (perceiving, organizing, and analyzing) information, using cognitive brain-based mechanisms and structures. Many research show that cognitive syle affects the students learning outcomes (Sholahuddin et.al, 2014), as well as students ability in problem solving. Students with a field independent (FI) cognitive style shows many characteristics as analytical, individual and independent, while students with a field dependent (FD) cognitive style tend to be global, social and less independent in perceiving, remembering, thinking, and problem solving [11], [12]. Although there is a tendency that FI student achieve learning outcome better than FD student, both FI and FD can be successful in learning as long as it is used the appropriate strategy to their style [13].

Accommodation of cognitive styles in learning process, may lead to emergence self-motivation. In addition, by knowing the students' cognitive style, teacher will be easier to design strategy that facilitate cognitive style differences and provide scaffolding, in order that learning takes place optimally. According to [14] scaffolding is considered as assistance from a more knowledgeable person (teacher or peer) that help learners to do a learning task beyond their capability. Dynamic scaffolding is a holistic, integrated, and synergic approach to support learners in accomplishing their learning goals through the just-in-time and proper integration of multiple resources (experts, peers, technologies, and learning context). Futher, refer to any research they discribe that scaffolding tends to be effective when provided through verbal discourse, teacher modeling, and pedagogical tools, such as triggering student sense-making, task-problematization, visualization and representations of knowledge, and construction of arguments and explanation.

The guided problem-solving-based learning strategy appropriate to student's cognitive development stage and consider the student's cognitive styles, was designed with the steps of attention, understanding problem, exploration, sharing, games, assessment and individual task or be abbreviated as @UnESa-GAIn learning strategy. It was valid according to experts rating [10] and need to field trial to evaluate it's realistic usability in science learning.

The problem of this study is: Could the @UnESa-GAIn learning strategy develops the science problems solving ability of elementary school students? How is the practicality of @UnESa-GAIn learning strategy? Learning strategy is concidered to be practice if it is easy to be applied by teachers and students and they have not obstacles, significanly in applying the learning strategy in elementary science class.

II. RESEARCH METHOD

This research applies the design research and development model of Dick & Carey [15]. This study is the step of field trial evaluation to evaluate practicality of the learning strategy for developing the science problem solving ability of elementary students. Field trial evaluation was conducted in two elementary schools of Banjarmasin, which are SDN Pasar Lama 1 and SDN Pasar Lama 2. Practicality of the learning strategy was observed and evaluate by using observation sheet of it aplicability by teacher, observation sheet of student activity in in science class and questionnaire of teachers and students response to it application. Rating category of the elements of learning strategy practicality are 3.51 to 4.00 = exelence; 2.51 to 3.50 = good; 1.51 to 2.50 = moderate; and 1.00 to 1.50 = poor. In addition researcher also conducted a limited interview both to the teacher and students to clarify their response.

III. RESEARCH RESULT

Fig.1 shows that the components of learning strategy can be implemented very well by the teachers in learning science in elementary school. Mean while Fig.2 shows that among the components of learning strategy relate to each other very well. Generally, implementation of the learning strategy reflect the design as theoretically designed in accordance with cognitive style, reasoning development of elementary school students, and the balance of teachers and students roles (Fig.3).

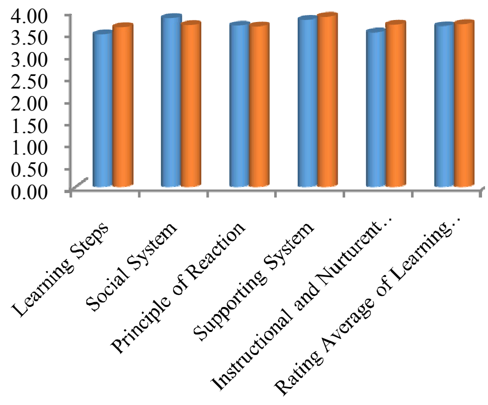


FIGURE 1. USABILITY OF COGNITIVE STYLE-BASED LEARNING STRATEGY ■ SDN PS. LAMA 1; ■ SDN PS. LAMA 3

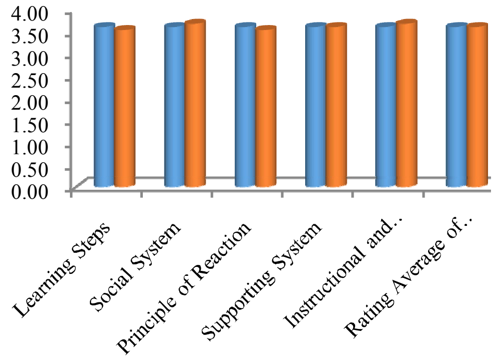


FIGURE 2. RELATIONSHIP BETWEEN COMPONENTS OF COGNITIVE STYLE-BASED LEARNING STRATEGY ■ SDN PS. LAMA 1; ■ SDN PS. LAMA 3

Fig. 4 shows that the aspects of students' learning activities of 2nd ,14th ,15th, and 16th have the lower scores than others. Eventhough, the average score of students' learning activities is good category, which concice of: (1) students pay attention to the teacher's explanation or guidance (2) students pay attention to other students' explanations (3) students present their ideas or opinions in problems solving process (4) students ask questions to teachers or other students (5) student response to the questions from teachers or other students (6) students try to understand the problems was presented by teachers through the students worksheet (7) students make predictions of the problem answer (8) students seek information from various sources or conduct observation to solve the problem (9) students presents the observation data (10) students interpret or explain the data (11) students make conclusions of problem solving (12) students prepare and present the result of problem solving (13) students evaluate the obtained solution students follow the evaluation in accordance with the purpose of learning (16) students work individual tasks, seriously (17) students read the textbook used in the study (18) students use worksheet (19) student do not perform irrelevant behaviour (talking about an unrelated matter, leaving the class, calling to someone, not paying attention, daydreaming, etc.).

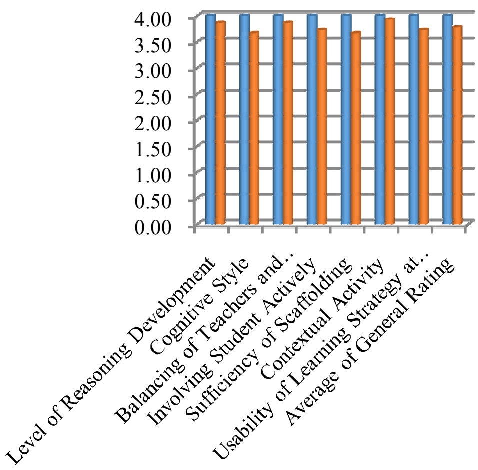


FIGURE 3. GENERAL RATING OF IMPLEMENTATION OF COGNITIVE STYLE-BASED LEARNING STRATEGY ■ SDN PS. LAMA 1; ■ SDN PS. LAMA 3

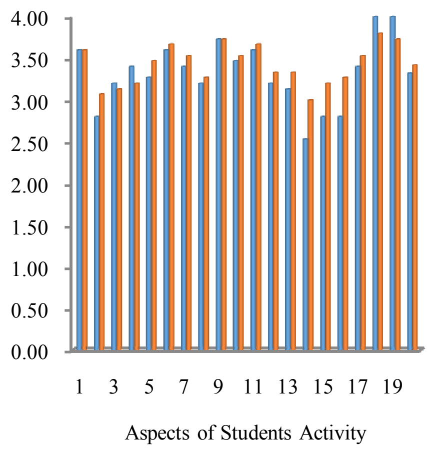


FIGURE 4. STUDENTS ACTIVITY IN IMPLEMENTATION OF COGNITIVE STYLE-BASED LEARNING STRATEGY ■ SDN PS. LAMA 1; ■ SDN PS. LAMA 3

Fig. 5 and Fig. 6 demonstrate that both teachers and students did not have the significant problems in implementing this learning strategy. Teacher say that they can apply all the aspect of cognitive style-based learning strategy with response in exelence category.

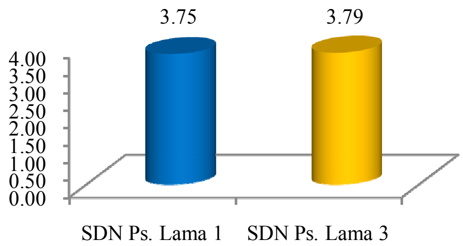


FIGURE 5. TEACHERS RESPONSE TO IMPLEMENTATION OF COGNITIVE STYLE-BASED LEARNING STRATEGY

Fig. 6a and Fig. 6b demonstrate that aspect of students' response of 5th dan 12th tend to be responded better; meanwhile the 6th dan 14th tend to be responded bad than the others. Although, the students' average response to implementation of this strategy is good category. The staements have to be responded by students consist of (1) learning this way makes me more motivate to follow the lessons (2) learning by this way makes me understand the science conceps (3) learning by this way provide me an opportunity to ask the problem encountered to the others (4) learning by this way train me the ability to solve the science problems (5) learning by this way train me working together and mutual respect among others (6) learning by this way train me critical thinking (7) learning by this way train me to courage to pose the opinions (8) learning by this way is fun and not strained (9) I am more confident in learning (10) learning by this way allow me to retain the lesson longer (11) learning by this way makes the lesson content related to daily events (12) individual tasks given help me to increase my understanding to learning materials (13) I never get tired to follow the lessons (14) I have no difficulty in following this learning (15) learning by this way is very suitable to my abilities (16) learning by this way is accordance to my learning style.

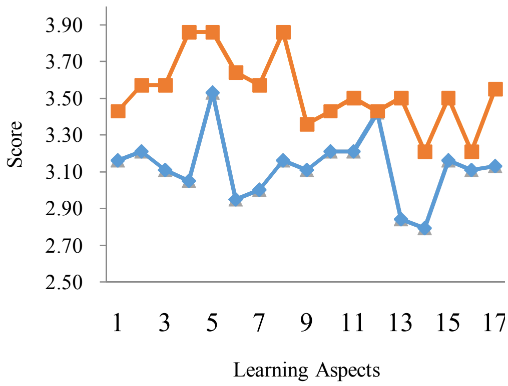
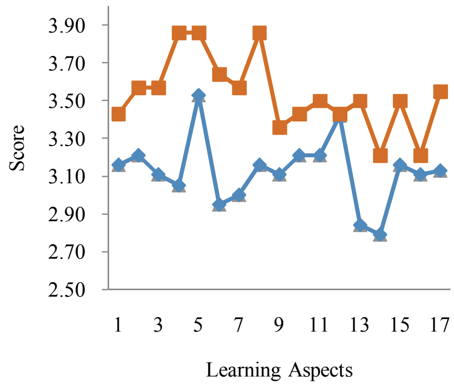


FIGURE 6A. STUDENTS OF SDN PASAR LAMA 1 BANJARMASIN TO IMPLEMENTATION OF COGNITIVE STYLE-BASED LEARNING STRATEGY ▲ FD STUDENT; ■ FI STUDENTS



FIGUR 6B. STUDENTS OF SDN PASAR LAMA 3 BANJARMASIN TO IMPLEMENTATION OF COGNITIVE STYLE-BASED LEARNING STRATEGY ▲ FD STUDENT; ■ FI STUDENTS

IV. DISCUSSION

Usability of the learning strategy demonstrate that it can be applied in the learning process according to the purpose of the development [16]. The study showed that teachers are able to apply properly all of the components of strategy that includes learning stage, social system, principle of the reaction, the support system and the instructional and nurturent effect (Fig.1). In addition, teachers are also able to perform the relationship between components of strategy as described on Fig. 2. This is in line with the expert's judgment where this strategy have the content as well as construct validity [10]. Teachers of both schools showed the similar performance in implementing all the components of strategy. Based on the classroom observations, generally teachers require adaptations in early learning, especially in consideration to students' cognitive styles. The cognitive style is a novelty concept for teachers, while the cognitive style is a importance characteristic of the strategy that determines how the principle of reaction will be applied in teaching. It relate to how teachers use different approaches to students with different cognitive styles as well as how teachers perceive and respond to what students do.

In general, the elementary school students of grade 6 were able to follow the steps and the process of learning by by applying problem-solving cognitive style-based learning strategy (Fig. 4). However, students need habituation of learning more independently. Based on this research, students activities which need to be improved continually includes: attention to explanations of other students, engaging in rehearsal games to deepen the concepts, following evaluation in accordance to the purpose of learning, and doing individual tasks seriously.

Elementary students tend to not accustomed to follow the student-centered learning strategy as well as interact to the others in group, and do not completing tasks independenly, yet. Learning independence or self-regulated learning (SRL) is a process that assists students in managing their thoughts, behaviors, and emotions in order to successfully navigate their learning experiences. SRL concise of three steps: forethought and planning, performance monitoring, and reflections on performance [17]. During the forethought and planning phase, students analyze the learning task and set specific goals toward completing that task. Meanwhile, in the performance monitoring phase, students employ strategies to make progress on the learning task and monitor the effectiveness of those strategies as well as their motivation for continuing progress toward the goals of the task. In the final reflection on performance phase, students evaluate their performance on the learning task with respect to the effectiveness of the strategies that they chose. During this stage, students also must manage their emotions about the outcomes of the learning experience. These self-reflections then influence students future planning and goals, initiating the cycle to begin again. According to [18] and [19], self-regulated learners are resourcefulness and engagement, so they perform better on academic tests and measures of student performance and achievement. This SRL will continue to evolve along with the development and experiences of individuals including study habits.

Ability of 6th grade of elementary school students in cooperative activities and investigation skills are still very weak. They are not accostomed to following learning activities that involve cooperative work, discussions, and inquiri [10]. Students' basic process skills such as observing, communicating and inferring is relatively poor, especially experimenting process skills [20] which is an advanced process skills. Thus process skills in one side is required in problem solving process, in the other hand they can be developed through problem solving-based learning activity. In this study, teachers have been provided scaffolding to the students gradually, in accordance with the students' cognitive style. In the early learning teacher explain and demonstrate the task who students are expected to complete on their own, provide step-by-step instructions (by verbal statement or by writing in worksheet) to solve the problem, and encourage students to interact with a new problem or task in their group. Ref. [21] classifyed this types of scaffolding to conceptual scaffolding (helps students decide what to consider in learning and guide them to key concepts), procedural scaffolding (helps students use appropriate tools and resources effectively), strategic scaffolding (helps students find alternative strategies and methods to solve complex problems) and even metacognitive scaffolding (especially assists students reflecting on what they have learnt).

Students appear to have been progressing in the involvement and independent learning from the first meeting to the next. Teachers reduce their role in the learning gradually. Teachers start the learning by applying problem-solving using direct instruction strategy, but then gradually they balance their role in the learning through cognitive style-based problem solving strategy. The proper scaffolding or guidance moves students towards their learning goals. It is a method of moderating the cognitive load of a learner. So, they will reach the learning goals esasier beacause they are in their zone of proximal development [22].

Some theoretical views suggest that rather than delaying a high level of guidance, providing it from the outset will optimize student learning. According to Cognitive Load Theory that working memory limitations dictate high levels of instructional guidance initially for domain novices, but that such guidance becomes redundant, and even dysfunctional, as learners acquire expertise . Ref. [23] report that a high degree of instructional guidance to the third grade children leads to shallow learning and transfer, the high followed by high (HH) group demonstrated a stronger understanding of control of variables strategy (CVS) than low followed by low (LL) group. Moreover, it was found that no advantage for preceding high guidance with low guidance. Novices benefit more from viewing detailed examples of solution steps, and as they gain domain expertise, they learn more from engaging in unstructured practice problems. Providing guides gradually also reported by [24] that the high school students were able to mastery on the chemistry concept and process skills properly, if the learning delivered from direct instruction to guided inquiry, but they can not follow the free inquiry learning strategy. Nevertheless based on questionnaires and interviews students to feel free and enjoy to participate in free inquiry-based learning. Thus giving scaffolding gradually from the strong to the less guides have been made the students learning easier.

This study shows that the rehearsal game helps students to understand the concept more deeply as well as provide a more funny atmosphere variation. This stage is most preferred by students, but there is a tendency requires a long time to apply. Therefore, in this study the teachers had a little problem in controlling the time. Even, at one particular meeting they had not opportunity to do this activity, but combined to the next meeting. It is a disadvantage of this strategy, because we have to involves students in exploratory learning activities in relatively limit of time. Understanding of science concepts greatly affect a person's ability to solve science problems encountered.

According to [25] the main purpose of problem solving based learning is not to study a large number of new information, but rather to practice the problem solving investigating skills and how to be an independent student. Solving the problem requires the activity of knowledge constructing and rules that have been studied that can be applied to new situations. Solving the problem involves the formation of high-level rules or the more complex rules. The complex rules are formed by combination of rules and defined concepts. Rules and defined concept are formed through the combination of several concrete concepts and to mastery the concrete concepts students have to master the discrimination. When they find a particular combination of rules that fit the solution, they have not only solve the problem, but also have learned something new or high-order rule [26], [2]. This study is in line with [27] reports that the application of PBL for grade 4 elementary school children in North Carolina increase the student engagement, knowledge and skills to solve problems is higher than direct instruction, although the retention rate of students' knowledge is no different.

Both of the teachers and students expressed no obstacles in implementation of this teaching strategy, but they just need to adaptation gradually (Fig.5, 6a and 6b). Our preliminary study showed that learning strategy usually applied by teachers in the classroom is expository-based to mastery the content knowledge. Therefore, by applying this strategy both teachers and students must change their learning habit. In this research, learning begins with direct instruction strategy and futher reduce the role of the teacher in learning, gradually. FI students with cognitive styles tend to provide a more positive response in all aspects of learning than FD students. The students responded positively almost all the statements about implementation of learning strategy, but both of the FI and FD students' response to the 14th statement e.i "I have no difficulty in following the way of learning this" lower than the others in both schools. Even, FI students at one of the schools responded just in moderate category. It shows that students still have a slighly difficulty in adaptation to this learning strategy. The strategy is relatively new for students in case of learning phase as well as learning tools that support. The form of problem solving worksheets, e.g was not known well by students on previous learning, yet. This fact suggest that the need to simplify learning tools or additional guidance when a community of students in a class are still have difficulties.

Based on the interviews, both FI and FD students like this learning strategy because they can apply the concepts directly through experiment. Students also consider that cooperative problem solving activity had been provided opportunity to brainstorm in understanding the science concepts. FI students ability to follow the lesson better than FD students. In learning process, FI students seemed take a role in exploration activities more than FD students. Although, this strategy seeks to strike a balance between activities that correspond to cognitive style both FI and FD.

Generally, the activity of problem solving requires a working systematically and analytically. So, it makes sense if students FI will tend to be more adaptable to this strategy. According to [28] that the FD/FI construct representing perceptual ability, but not extensive cognitive style. While, [29] found that effects of cognitive style on motor performance may be at the level of perception is not at the level of the motor. Perception is our sensory experience of the world around us and involves both the recognition of environmental stimuli and actions in response to these stimuli. Through the perceptual process, we gain information about properties and elements of the environment that are critical to our survival. Perception not only creates our experience of the world around us; it allows us to act within our environment. Perception includes the five senses; touch, sight, taste smell and taste. It also includes what is known as proprioception, a set of senses involving the ability to detect changes in body positions and movements. It also involves the cognitive processes required to process information, such as recognizing the face of a friend or detecting a familiar scent [30]. So the more better the perceptual ability, the more adaptable of the student to follow the learning strategy that involve problem solving activity.

This study reflect that the teachers are able to apply the strategy and actively involved in learning through providing the adequate scaffolding base on the students' characteristics and abilities, so it can reduce the difficulties experienced by FD students. Teachers can apply the stages of learning strategy, and relationship between components of the strategy very well. In addition teachers also able to perform very well the general characteristics of strategy i.e problem solving, consider the development of students' reasoning, cognitive style, knowledge construction, and cooperative process. In addition, students are able to follow the lesson well also, although FI students tend to respond more positively to the implementation of strategy than FD students.

Some factors that require attention for optimizing usability of learning strategies are: size of class or students' group in learning, simplification of individual tasks, and control of instructional time. Generally, at elementary school of Indonesia the average number of students in a class is relatively large, 30-32, even at two schools in this study, each class consist of 33 and 39 students. If instruction will be designed in groups with members of four students, there will be a minimum of 8 groups. Consequently teachers will have difficulty to manage the cognitive style-based learning strategy. The fewer of class size or groups, thus teachers will be more easily to manage the classroom and provide learning guidance. At small groups try out, with two groups in one clas of SD Muhammadiyah 8-10 Banjarmasin (Sholahuddin et al., 2015), showed that teacher more easily to manage the classroom and almost all the students can be encouraged to engage in the problem solving process. Eventhough, in particular the individual task is still relatively difficult for the students. This is caused by their level of independence have not been developed, yet. So in this strategy individual tasks more emphasis on the deepening of science concepts being studied in the form of answer the question provided in student book.

V. CONCLUSION

The cognitive style-based learning strategy was proofed it practicality in science learning at elementary school. It mean that it can be aplly by the teachers in science class to develope the science problem solving ability of elementary students. Experts and practitioners have been judge that the learning strategy is valid with validation score is exelence category. The usability of learning strategy, relationship between it elements and it characteristics are exelence category. respectively. In addition, students perform a good learning activity along the science class. Teachers as well as students did not have obstacles, significanly in applying the learning strategy in elementary science class. Field independent student tend to give more positive response than the field dependent one. It is indicate differentiation of perceptual ability among them which led to difference in processing information and ability to solve the problem.

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SE – 04

'New Pedagogies' of Experience Based Learning Form in Science Learning

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Abstract—In this digital era, information and knowledge become one of the things that can be produced, transferred, and consumed by the public rapidly. This is due to the advancement of information and communication technology, which gives an impact on education. Information and communication technologies become an important part too in learning, including in learning science. At the same time, the Indonesian education including science education are required to produce quality human resources superior to face global challenges as a result of the ASEAN Economic Community (AEC), which began in late 2015. Both require science education to improve quality by utilizing information technology development and communication, stick to science and nature at the same time produce a superior human resources. One alternative solution through 'new pedagogies' form such as experience based learning via online or experiential e-learning. Thus learning science are believed to develop conceptual skills, digital skills, and manual and practical skills of students.

Keywords: *new pedagogies, experience based learning, science learning.*

I. INTRODUCTION

While advancement in Information and Communication Technology (ICT) continues to propel many fields, such as economic, political, social and educational reforms. It is in the field of education that its integration is perhaps most challenging. In schools, colleges and universities, a major requirement for a facilitative academic environment today is digital presence. The development of advancement in Information and Communication Technology (ICT) is transforming the way people learn at a time. The first trend is the rapid acceleration of technological change and the demand that this change places on education. The second major trend is the change that the digital revolution has brought to media usage. This represents not just a shift in learner habits, but also a shift in the way learner interacted with the medium or object.

At the same time, the Indonesian education including science education are required to produce quality human resources superior to face global challenges as a result of the ASEAN Economic Community (AEC), which began in late 2015. Both require science education to improve quality by utilizing information technology development and communication, stick to science and nature at the same time produce a superior human resources. Student as a part of global community, need to be involved to address these issues. Many of the challenges of 21st century will require innovative solutions that have a basis in scientific thinking and scientific discovery. One of the efforts to solve the problem is by implementation experience based learning.

Teaching and learning experiences in education are being transformed by digital technologies. This has required a rethink to identify the pedagogy that underpins the transformation. Modes of learning have changed dramatically over the past two decades—our sources of information, the ways we exchange and interact with information, how information informs and shapes us. But our schools—how we teach, where we teach, who we teach, who teaches, who administers, and who services—have changed mostly around the edges. For both teachers and learners, the digital revolution is transforming the traditional classroom from an uninspiring, laborious and tasking setting to make a expressive and collaborative teaching-learning environment. A teacher's role as the guide and stage-manager in the emerging digital context cannot therefore be over stressed. Indeed, effective integration of technology into teacher education is a critical variable in the production of competent and dynamic teachers of the twenty first century. It is now realized that a technology-enriched learning environment is indispensable when trying to equip learners with the skills, ideas and information required to improve critical thinking, collaborative skill and technology literacy.

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With the expansion of digital learning and technology in the classroom, professional development of teachers must transition to fully realize the potential of these resources to foster student learning. This encompasses using technology, both to guide instruction and to measure, evaluate and understand student learning through data-driven instructional methods. In addition to this shift in role, many teachers lack proficiency with technology. The gap between the teacher role in digital learning environments and teacher technology skills, prevent digital learning and technologies from being used effectively. To make the transition from the traditional role of disseminating content knowledge to that of instructional design in guiding students' discovery and application of information, teachers require a significant investment in time and learning. Teachers have cited professional development as an important component of preparing them to use technology effectively in instruction, including experiential based learning in science learning.

II. DISCUSSION

Since the end of 2015, Indonesia have entered the era of the ASEAN Economic Community (AEC). The era of the ASEAN Economic Community (AEC) becomes a challenge and opportunity for the Indonesian people. The impact of the AEC not only in trade but also all sectors. All sectors must be ready to face this AEC implementation. One thing need to be prepared is the Human Resources (HR) quality. In relation to anticipate the application of the AEC, education is an important element that should receive top priority. So, education should be able to adjust with the times, including rapidly development of technology information and communication in this digital era.

Technology can support the learning of science in terms of providing resources, organizing data, or means of communication. Excellence and computer literacy has increased significantly with the development of multimedia systems and telecommunications capabilities. It provides a logical consequence to the performance of teachers, as stated Chiappetta & Koballa (2010) "Computer and other electronic technologies are changing the work of science teachers as much as they are changing the work of scientist".

Changes in science, technology, and society is rapidly increasing demand change ways and strategies in teaching learners about something they need to know for their future, so the need for learning that is able make study for learners to discover facts and information, process and developing it to into something valuable and beneficial for him/her. The necessary learning is learning that not only repeat the ideas, but the learning is able to explore the ideas of learners. This is so that they are capable of creativity and ready to deal with the problems of the future.

Computer Assisted Instructional (CAI) in ICT provides the learning interaction between students (learners) and a computer with a variety of contents with or without the assistant (Lockard, Abrams, & Many, 1997 in Konukman, 2003). CAI utilizes a computer to facilitate and improve the quality of learners. Learners interact with computers using their own step and the role of a facilitator or coach. CAI directing the attention of students to the different sections in sequence learning program without the help of an educator directly. The integration of CAI framework needs to consider integrating technology in learning science. Bull & Bell (Chiappetta & Koballa, 2010: 258) argues framework integrating technology in the science learning by linking the chain of technology as well as its applications to support science learning, and enables students to understand science naturally. The framework can be described in Figure 1.

Science			
Science as a Body of Knowledge	Science as a way of investigating	Science as a way of thinking	Science linked to Society, Technology and Environment

Technology Applications in Science Education		
Multimedia	The collection and analysis of data	Communication and Collaboration

Integration of Technology in Education Science Tools		
Picture, Video, animation, audio-recording	Probeware, geotechnologies, online data, simulation	*Internet project, internet inquiries*

FIGURE 1. FRAMEWORK FOR INTEGRATING TECHNOLOGY IN LEARNING SCIENCE (Chiappetta & Koballa, 2010: 258)

CAI is central to advancing science education and improving student learning outcomes. This view evident in modern learning which stated student learn science by seeking understanding from multiple sources of information, ranging from hands-on activity to internet searching. So, Teacher pedagogy must evolve to meet the demands of changing classroom environments and learning needs of contemporary students. There is a changing pedagogical role for the teacher in CAI rich interactive because a classroom enhanced with digital educational technology requires interactive pedagogy. The technology can be used actively to facilitate interaction with and between students and immediate constructive feedback to the students. Pedagogical interactivity is the mediation of interaction between the teacher, students, and the technology. There are five point of the nature of whole class pedagogical interactivity. It is ranging from a lecture approach with high teacher control to a collective approach with a high degree of student's control. Questions types and the nature of whole class discourse were indicators of pedagogical interactivity: (1) lecture: no interactivity or only internal interactivity; (2) low level/funneling questioning: rigid scaffolding and surface interactivity; (3) probing questioning: looser scaffolding and deeper interactivity; (4) focusing or uptake questioning: dynamic scaffolding and deep interactivity; (5) collective reflection: reflective scaffolding and full interaction. Integrated with interactive activities were higher order question and student led discussions. Questioning was the means for focusing students' attention, supporting action and for making connection among facts or data. Cognitive approaches to learning cover a very wide range (Murcia in Tan & Kim, 2012: 227).

There are various specialized learning purposes include drill and practice, tutorials, games, simulations, discovery / inquiry, and problem solving in CAI. Each has different rules in operation. In this case, our focus discussion in 'new paedagogies' of experience based learning form. David Kolb (1984: 28), describes the experience based learning process as "a process whereby concepts are derived from and continually modified by experience". Kolb's (1984) work on the learning cycle is among the most often cited in relation to experiential learning. Kolb theorized that learning is a continuous cycle of experience, observation, and reflection; with each cycle, the student modifies his or her understanding and then tests the new insight with another cycle of experience and observation. Components of the learning cycle, in turn, correspond to preferred learning styles.

Experience based learning in 'new paedagogies' form theory borrows its core concepts from Dewey's principles of the continuous interplay between experience and learning, and Freire's dialectical interactions between students and teachers. It follows that experience based learning in 'new pedagogies' form have integrated Freirean dialectical interactions and Dewey's continuity of experiences into online courses (Carver et al., 2007; Lalonde, 2011). Experience is always a critical element in learning. This also applies to e-learning: Quality is directly proportional to the degree that experience is involved. Even good e-learning courses will increase if experience based learning concepts are brought to the fore front.

While the technology might facilitate a dynamic and interactive educational experience, making it happen depends on many factors beyond the technology (Bullen, 1998). The attributes of e-learning like time- and place-independence, many-to-many communication, computer mediation, and interactive communication, do not ensure. Advocates of experiential learning are often highly critical of online learning, because, they argue, it is impossible to embed learning in real world examples. However, this is an over simplification, and there are contexts in which online learning can be used very effectively to support or develop experiential learning, in all its variations:

1) Blended or flipped learning: although group sessions to start off the process, and to bring a problem or project to a conclusion, are usually done in a classroom or lab setting, students can increvasingly conduct the research and information gathering by accessing resources online, by using online multimedia resources to create reports or presentations, and by collaborating online through group project work or through critique and evaluation of each other's work;
2) Fully online: increasingly, instructors are finding that experiential learning can be applied fully online, through a combination of synchronous tools such as web conferencing, asynchronous tools such as discussion forums and/or social media for group work, e-portfolios and multimedia for reporting, and remote labs for experimental work. Indeed, there are circumstances where it is impractical, too dangerous, or too expensive to use real world experiential learning. Online learning can be used to simulate real conditions and to reduce the time to master a skill. Flight simulators have long been used to train commercial pilots, enabling trainee pilots to spend less time mastering fundamentals on real aircraft. Commercial flight simulators are still extremely expensive to build and operate, but in recent years the costs of creating realistic simulations has dropped dramatically.

However, many forms of experience based learning can and do have strong guidance from instructors, and one has to be very careful when comparing matched groups that the tests of knowledge include measurement of the skills that are claimed to be developed by experiential learning, and are not just based on the same assessments as for traditional methods, which often have a heavy bias towards memorization and comprehension.

'New pedagogies' of experience based learning form provides an already existing framework in which to develop a new model for e-learning, one that features the individual, alone or in creative interaction, as the mobile center of gravity of the learning environment. The students and teachers become more effective change agents, develop a sense of belonging to a community, and master both skills and knowledge in an effective experiential education program. Students engage in multiple forms of active learning in authentic settings, draw on their individual and/or collective experiences, and make connections between lessons covered and situations they expect to face in the future; such as they experience, share, process, generalize, and enact their learning. Teachers create opportunities f or students to reflect on their experiences in order to assure assimilation but the learners themselves are the center of this model.

Carver, et.al. (2007) analyzed different types of 'new pedagogies' of experience based learning form based on the degrees to which students' experiences and interactions are drawn into the course design and activities.

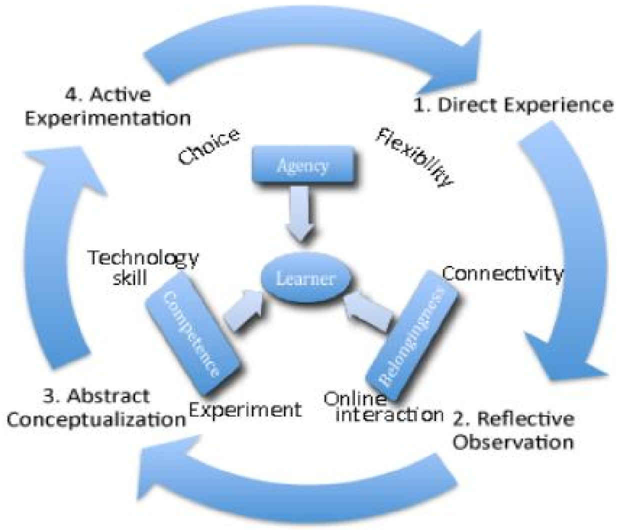

FIGURE 2. THEORITICAL FRAMEWORK INTEGRATING KOLB'S LEARNING CYCLE AND CARVER ET.AL (2007) NEW PEDAGOGIES' OF EXPERIENCE BASED LEARNING FORM
OR EXPERIENTIAL E-LEARNING CORE CONCEPTS
(Source: Baasanjav, 2013: 576)

'New pedagogies' of experience based learning or ee-learning theory based on figure 2, which makes a conscious effort to integrate students' experiences into the curriculum (Carver et al., 2007), provides a useful framework to support the full learning cycle proposed by Kolb (1984). Particular emphases are given to students' competence with digital media, learner centeredness, agency bolstering through choices and control over one's education, and belongingness. Students' immediate experiences with digital media mimic the real world situations in which students find themselves in, and this allows the researcher to apply some core concepts of experiential e-learning at the undergraduate level. Experiential e-learning theory helps educators understand how the practicality of technological and skill differences of students plays out in the online classroom without uncritically buying into the "digital natives" arguments

Traditional e-learning uses information and communication technologies to facilitate participant connections, expand access of information, and provide learning opportunities not necessarily constrained by time or distance. 'New pedagogies' of experience based learning form or ee-learning leverages e-learning technology with the philosophy and methodology of experiential education, promoting inquiring forms of community that engage learners in the experiences through which knowledge is created (Trevitte and Eskow, 2007; Riedel et al. 2007). Like experiential education, 'new pedagogies' of experience based learning form places great emphasis on learner participation in authentic tasks and place learner participation and reflection at the center of pedagogical practice. Indeed, experiential education models now being adapted for 'new pedagogies' of experience based learning form, such as service-learning and knowledge-building paradigms. Nevertheless, such models are often vague in defining the specific role of learner participation in the processes of knowledge production and meaning making. More students' experiences and interactions are drawn into the course design and activities, the more online education can bolster agency, belongingness, and competence among online students. Carver et.al. (2007) go on to explain the core concepts of 'new pedagogies' of experience based learning form:

(1) Learner centeredness refers to an online class offers a learner much more flexibility and control over the learning process. A learner often decides when, where, and from what sources he or she learns, and this situation requires that the teacher focus on an individual learner, his or her interests, and his or her prior experiences and learning styles

(2) Agency refers to the sense of a learner being capable of taking actions and making differences.

(3) Belongingness because a range of online communication strategies that have become available in recent years offer more connectivity between teachers and students, as well as among students. It can thereby increasing the potential for a student's sense of belongingness

(4) Competence means acquiring knowledge, mastering skills, and learning to apply what is learned – is the focus of all education, whether in traditional or in online learning environment

The key factor in designing 'new pedagogies' of experience based learning form environments is intention. Teachers who use online pedagogies must create curricula purposely designed to include the various elements of experiential learning: reflection opportunities, active projects, and conceptual resources. Without such intention, technology features—rather than educational outcomes—can begin to drive content. It is all too easy to get wrapped up in designing a course around a specific technology, trying to use all of the features that are available in some programs, or lamenting that the available programs do not have certain capabilities. A course-design approach that begins with ideas for activities and then decides which technology features best support those activities encourages a more effective use of technology.

There are several example implementation of 'new pedagogies' of experience based learning form in science learning.

1. Service learning in science learning
   E-service in science learning involves opportunities for students to meet young learners, face current environment issues, and assist in meeting a variety of community needs. Students gained insight on local research and found that participating in the scientific process was exciting. Participation in service learning will provide hands-on experience that will allow student to connect with community members who can impact student skill and career development in a variety of ways. Because service learning often involves collaborative project work, student will be able to practice communication and teamwork skills and provide evidence that student can take initiative and are reliable. Student will also be able to practice networking skills, meeting people who student can connect with to explore internship or job opportunities. For example, The DLiTE cohort program launched in the fall of 2002 in e-service learning of science component: the activity Several students volunteered at summer schools and camps, tutoring students in physical science and biology. Other students volunteered for plant and animal inspection through the Minnesota DNR.Under the guidance of the local DNR, one student boated around a four-mile lake looking for Purple Loosestrife. This exotic plant can grow up to six feet above water and three feet below, producing up to 2.7 million seeds per plant. In response to concern that the exotic weed had invaded a lake treated for it in 1999, the student was asked to collect samples and press them for future inspection. Part of her responsibility was to determine the weed's appearance through her own research on the Internet. It appeared to the student that the project was a "fringe" job that the local resource officials could not tend to. Most likely, because of budget cuts, she was the only person available to carry out the task. She provided a needed service with no extra cost to the agency. Another science student worked as a surgical technician in an operating room, examining deer brain tissue for signs of Chronic Wasting Disease. She assisted in the collection of an abnormally shaped protein called a prion, which damages brain and nerve tissue (Strait & Sauer, 2004)
2. Scientific inquiry in a computerized laboratory environment
   Computer technology is so common place in the practise and advancement of science. Generally, scientists utilize computer technology in the laboratory for data gathering, storage, analysis, simulating, modeling, and facilitating of automatic control and sharing of instruments. This type of environment learning could transform the way science is taught by fostering inquiry, helping students do investigation, observation, collection, analyzing, and make interpretation of scientific data, as well as to facilitate modeling of scientific principles. The computerized laboratory environment is advantageous in that it provides students with substantially more opportunities to construct an independent understanding of physical phenomena and scientific principles, acquire scientific inquiry skills, and increase motivation and confidence in learning science. For example, virtual laboratory in science learning from https://phet.colorado.edu/en/simulations/category/by-level/middle-school.

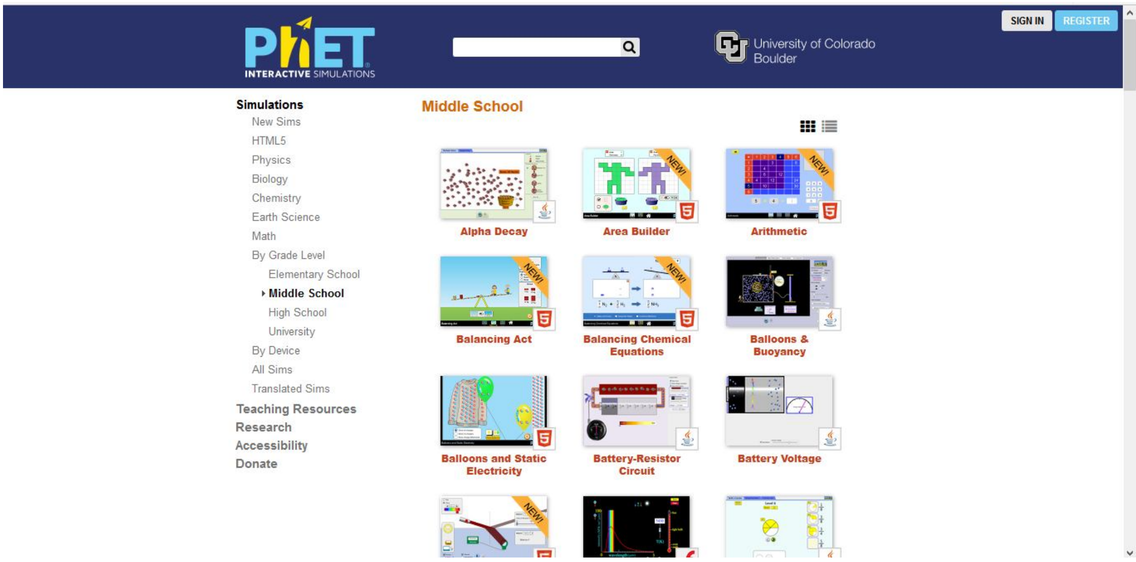

FIGURE 3. VIEW OF PHET.COLORADO. EDU SIMULATION

III. CONCLUTION

Based on the discussion above, it can be concluded that:

1. 'New pedagogies' of experience based learning form or experiential e-learning is provides an already existing framework in which to develop a new model for e-learning, one that features the individual, alone or in creative interaction, as the mobile center of gravity of the learning environment.
2. The core concepts of 'new pedagogies' of experience based learning formor experiential e-learning: learner centeredness, agency, belongingness, competence, and center of gravity.
3. The key factor in designing New pedagogies' of experience based learning form or ee-learning environments is intention. The teachers who use online pedagogies must create curricula purposely designed to include the various elements of experiential learning: reflection opportunities, active projects, and conceptual resources.
4. 'New pedagogies' of experience based learning form or experiential e-learning can develop conceptual skills, digital skills, and manual and practical skills of students.

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SE – 05

Collaboration of Traditional Games with Science-Based Inquiry and Scientific Approach

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Abstract**—**In the era of technology, traditional games has been largely abandoned by the nation's generation. Learners emphasizes technology in learning, so forget about the other aspects of his life, especially his social life. Learning should be returned to the humanitarian aspects and the emphasis on the development of creativity, taste, and imagination to become the generation that responds to the environment. Through the collaboration of traditional games with science-based inquiry and scientific approach can equip learners to learn science in a free and fun.

Keywords:*traditional games, science, inquiry, scientific*

I. INTRODUCTION

Study in Tamansiswa use the among system, which puts children at the center of the educational process and tutors as mentors (Ki Hajar Dewantara, 1977: 12). Children as human nature independent so as to educate given outer and inner freedom to grow and develop. The learning will make the child actively stimulated innovation and increase their knowledge so that it can be a useful man for himself and the community. However, problems are often a constraint by teachers in teaching science is the lack of learning resources available in schools. Teachers generally only know the learning resources are library, internet and the books. In fact, all were used and specific objects including learning resources. Aan Hasanah (2012: 151) explains that learning resources are all over the place or the environment, objects, materials, books, events / facts that is happening and those that contain the information can be used as a vehicle for students to make the process of behavior change. These problems lead to learning science becomes dry activity. This resulted in the science lesson are not meaningful and students think science lessons are very serious, sinister and makes boring. The learning makes students feel fettered and burdened. The learning condition is contrary to science as knowledge gained through activities or laboratory experiments. In addition, science teaching will be more easily understood by the students' learning through concrete objects.

This paper explains why and how the culture (especially the traditional game) as a source of learning can be considered as an alternative to learning science. It analyzes the limitations of traditional games in teaching science and identify how traditional games can be more practical and effective approach. Indonesian traditional games in today's increasingly faded, this is because the development of technology. Kids who are interested in video games, and games android so rarely interact with their friends. This time, Indonesian traditional games rarely used by students/current generation. Whereas traditional game requires no hardware or software equipment to play it as well as the tools readily available. The traditional game is very simple and easy enough to follow. The ambiance stiffness in socializing children will soon melt and familiarity will be easily obtained after this game. In learning science, culture-based learning resources to provide an environment of learning science interesting and fun for students. Teachers and students made possible interact and participate actively in the learning culture based owned and known. Teachers and students also feel the intimacy and acknowledged.

II. DISCUSSION

The local culture especially traditional games get less attention from the teacher to be applied in their science lessons. This is the challenge to be able to integrate the local culture in the form of traditional games into science teaching so that students can learn science by encouraging curiosity with interesting and fun atmosphere. Teacher roles in directing potential students to explore diverse cultures, especially the traditional game is already known, as well as developing the culture. The interaction of teachers and students will accommodate the creation of meaning from knowledge gained in these subjects at school by each individual.

A. Traditional Games as a learning resource

According Anggani Sudono (2000: 11), seen from the development of the child to learn, it takes learning resources which can support factors of cognitive, psychomotor and affective. Management Games traditional or folk games is clear that all of these games contain the movements of the body, hands, feet and other body to interact with a group of playmates. Learn while playing can be done in science learning. Aan Hasanah (2012: 76) states that learning is a process of mental and emotional or thinking and feeling. Through the game, students can develop their potential in cognitive, psychomotor and affective. Alexon (2010: 14) argues that learning that integrates the local culture in the learning process, not only can facilitate the improvement of student learning outcomes in certain subjects, but also students' appreciation of the local culture. Daryanto and Muljo Rahardjo (2012: 164) adds that the culture-based learning is not just transferring or conveying culture or cultural manifestation but use culture to make students capable of creating meaning, through the boundaries of imagination and creativity to achieve a deep understanding of the material being studied.

The traditional game as one of the living culture and is integrated with the students and community of local culture is a theme that can be developed in the learning process. The students are doing a game in the field of education should be to collect and amplify the information from different sources, and thoroughly review the subject matter. Teachers should guide the students and help students in integrating traditional game with the material being taught. Teachers give students the chance to discuss and exchange opinions with their friends. This process aims to improve their memory retention, engagement, editing skills, and knowledge concerning the concept of the IPA. This process creates a traditional game in science learning engages students in activities where knowledge is the realization of a kontektualisasi and learning objectives.

Media and other learning resources used by teachers to provide assistance in the form of student conduct exploration observing (observing), attributing the phenomenon (associating), ask or formulate the problem (questioning), and conduct experiments (experimenting) or further observations. Learning resources in the form of culture can use the traditional game. The traditional games include egrang, permainan bola bekel, lompat tali, layangan, gangsing, cublak-cublak suweng, ular naga, klontengan, gundu/leker, patok lele, benteng-bentengan, kasti, gobak sodor, engklek, congklak, tarik tambang, bedil bamboo, balap karung, bakiak, rorodaan, ketapel, yoyo and so on. Such games can be developed as a source of learning science on draft upward lift force on the fluid in the form of gas that is by using a kite. Kite on the game can also be associated with the measurement at the time of making kites, determine the wind direction, energy and so forth.

B. Implementation of traditional games in Inquiry-based science learning and Scientific Approach

The traditional game presents events or activities of interest to nurture the curiosity of the students so that raises questions "what, why and how" of the events that occur in the game. In a further development into a "what if ..." as a form of exploration of the students against the experienced (Wenno, 2008. 61). Abdul Majid and Chaerul Rochman (2014: 143) adds that the ability of children to learn through experience, namely 1) the students involve themselves fully in new experiences; 2) students observe and think about the experience of various aspects; 3) students create concepts that integrate observations into sound theory; and 4) students using theory to solve problems and make decisions. Based on this, the science lesson should use a scientific approach through observe, ask, try, reason, and communicate reinforced by using the inquiry.

Three key steps in the development process of science (scientific method) is observed, inference (formulate explanations based on observations, including finding patterns, relationships, and make predictions), and communicate (Kemendikbud, 2014: 5). How to make use of culture as a source of learning? The value of culture as a source of learning depends on the skill to use it. Adrian Rustaman (1996: 5) explains that each learning resources should be used for specific purposes, namely: to help solve the problem, it can explain the concepts and principles of science, and increase the tendency of students to explore the natural surroundings.

Understanding of concepts in science must be obtained by the students actively use their skills by involving cultural process as a learning resource. With his own experience students will have the provision to seek and find the concept or principle. Students no longer learn science but learned through science. Teachers should encourage students to construct knowledge in his mind. In order to truly understand and can apply the knowledge, the students in learning to use traditional games should be encouraged to work to solve problems, find everything for himself, and has struggled with his ideas. This was confirmed from the results of research Wijaya, et al. (2011: 149) that"traditional Indonesian games can support the learning of linear measurement. The analysis of the teaching experiments showed that conflicts of fairness while playing the game could be used to help students to acquire the concept of a standard unit of measurement". This shows that through the Indonesian traditional games can help students in getting the concept of the material in a fun way.

Based on the research results Astuti Wijayanti and Aris Munandar (2012) concluded a model to develop outdoor learning in the learning that can be described as follows:

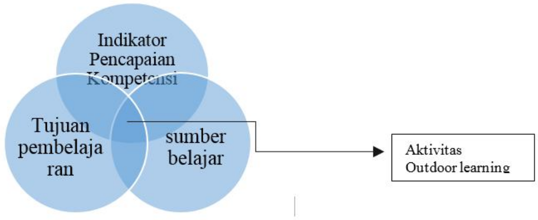

FIGURE 1. MODEL DEVELOPMENT OF OUTDOOR LEARNING

Model development of outdoor learning can be applied to develop the traditional game in learning science. Model of traditional game development using learning resources local culture. Implementation of learning that integrates traditional games into learning science can be conducted inside and outside the classroom. The model that contains elements of the indicators of achievement or competencies, learning objectives and learning resources necessary to develop the local culture in preparation of lesson plan-based culture is described as follows:

Competence achievement indicator is used as a marker of achievement of basic competence is characterized by behavioral changes that can be measured which includes attitudes, knowledge, and skills. The learning objectives describe the process and expected learning outcomes achieved by learners in accordance with the basic competencies. Learning resources are references, objects and / or materials used for learning activities, in the form of print and electronic media, speakers, as well as the physical environment, natural, social, and cultural. Determination of learning resources based on standards of competence and basic competencies and subject matter, learning activities, and indicators of achievement of competencies. Learning resources using traditional games. To integrate traditional game with the science lesson to make it easier to understand the students by using worksheets. According Paidi (1999) mentoring students doing science process uses written guidelines (in the form of a practical example for worksheet) and guide oral teacher (introduction at the beginning of the event) and clarification (at the end of the activity), as well as guidance during the manufacturing process of experimental design and implementation, capable improving scientific skills of the students. EndangWahyuningsih, Hantoro and Sifak Indana (2011: 31) adds that in order to improve scientific performance of students, it is recommended to use the inquiry worksheet challenging and intensive guidance in the application of science learning.

How to implement inquiry-based science teaching and scientific approach utilizing traditional games as a learning resource can be done with the following steps:

1. Analyze Content Standards are standards and basic competencies that pertain to the standard kompetansi each class graduates to develop their subject matter.
2. Develop a syllabus to be developed in the learning activities.
3. Analyzing the matter of integrity by referring to some sources this book to determine competence achievement indicator.
4. Choosing a traditional game which is suitable for use in learning.
5. Describe the subject matter became an essential matter of fact, the concept of principles and procedures that can be developed or explored through the neighborhood.
6. Develop indicators of achievement of competencies using improved operating verb of remembering up to a higher level and continued with the elaboration of the goal.
7. Based on the analysis of the essential matter of fact, the concept of principles and procedures to be developed into student activity or learning experience with outdoor learning.
8. Develop lesson plans through a variety of methods and models of learning as PAIKEM, contextual learning and cooperative learning as well by applying the scientific approach.
9. Make worksheet that leads to the concept of the material by connecting the activities performed in traditional games.
10. Make judgments based assessments to measure the success of a product, process, or judgment of other tasks.
11. Conduct learning according to plan and record weakness for further improvement.

Learning science that integrates traditional game with a scientific approach requires teachers to master standard implementation process, the traditional Indonesian games, scientific approach and process skills in inquiry learning implementation as the demands of the curriculum. The application of this learning can only be applied to SK-KD certain learning relevant to the learning resources in the form of Indonesia traditional games.

III. CONCLUSION

Learning science by using learning resources in the form of traditional games can be directed to develop students 'ability to acquire knowledge and reintroducing the game to train the students' social skills. Learning resources in the form of traditional games will help those involved in the school and outside the school environment so as to create the atmosphere of the classroom or the learning process fun and helps improve the quality of education by not ignoring the elements that become embedded in the child.

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SE – 06

Developing an Authentic Assessment Science Process Skills, Critical Thinking Skills and ProblemSolving Skills

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Abstract—This research is aimed to know the procedure of instrument development of authentic assessment and to know the worthiness of authentic assessment instrument of development result is seen from the content validity by the validator. This research is development research by model of non-test instrument. Development model of non-test instrument used has steps as follows: (1) determining of the instrument specification, (2) writing the instrument, (3) determining the instrument scale, (4) determining the scoring system, and (5) beating out the instrument. The writer used quantitative and qualitative technique to analyze the data obtained. The qualitative approach was used to analyze the input from experts and teachers, and thequantitative approach was used to analyze the results of experts' validation using Aiken's validity. Conclusion of this study are as follows: (1) The procedure of the authentic assessment development follows the stages of research and development. The stages include pre-survey research, problem analysis, analysis of curriculum, research studies, experts consultation, and drafting an instrument. The stages of development include experts' validation. (2) The quality of the developed products the developed authentic assessment has a valid criterion as an instrument, in terms of aspects of the construct, substance, and language. All these aspects meet a very good criterion and can be used with revisions.

Keywords: *authentic assessment, science process skills, critical thinking skills, problem solving skills*

I. INTRODUCTION

Natural Sciences is the mastery of facts, concepts, principles, and a process of discovery. The process of discovery in learning the natural sciences in accordance with the Nature of Science (NOS) means that science is a way of knowing. Lederman, et al. (2002:231), stating that "that science is a way of knowing and there are values and beliefs inherent to the development of scientific knowledge". Based on these statements, NOS is defined as the concept of complex natural sciences involves philosophy, sociology, and historical knowledge.

Natural Sciences is the mastery of facts, concepts, principles, and a process of discovery. Learning the natural sciences is based on the contents of the standard form students who have a body of knowledge; standard process will shape the students with scientific skills, thinking skills and strategy of thinking; the standard scientific inquiry will form students capable of critical and creative thinking; as well as a standard assessment evaluates students humanely.

Sheeba (2013: 109) defines the science process skills as a device suitable skills in the disciplines and reflect behavioral scientists.Abungu, Okere, & Wachanga (2014: 359) states that the science process skills is an activity the students to conduct scientific investigations to develop scientific knowledge and skills. Science process skills include some skills in the students' activities. Types of science process skills according to Martin (2006: 68) include: a) basic science process skills including observation, classification, communication, measurement, inference and prediction; b) integrated science process skills include identifying and controlling variables, formulate and test hypotheses, interpret data, define operational, conducting experiments and building models.

Critical thinking is defined as the activity of the mental discipline to think reflectively and reasonable to evaluate arguments or propositions to decide what to believe or do (Huitt, Ennis in Çimer, 2013).Critical thinking is also a cognitive abilities and strategies that increase the likelihood of the expected results, thinking that aim, reasoned, and goal-oriented. This thought includes solving problems, formulating conclusions, calculated the odds and make a decision (Halpern in Frijtersat. al, 2008). Problem solving skills are an action to resolve the problem or process that uses the power and benefits of mathematics in solving the problem, which is also a method of discovery solutions through the stages of problem solving.According Arends (2008: 45) problem based learning is an approach to learning in which students work on authentic problems with a view to construct their own knowledge.

The learning process is directed at the development of the third realm of knowledge, attitudes, and skills should be implemented as a whole or holistically, meaning the development of one domain cannot be separated from other domains. The question that still occurs in the process of learning one's current assessment of the natural sciences still dominated the test form, which can only measure the realm of knowledge. The fact that learning the natural sciences is not always judged by using an assessment form test to measure student learning objectives. Assessment can be done by collecting information about students to give more accurate information about the skills and attitudes of students. The assessment directive can also be done to measure the learning process of students (Phopam 2008:6). That kind of assessment called the authentic assessment.

Mueller (2006: 1) said authentic assessment is an assessment of immediate or direct size so that the assessment will be more obvious when votes directly to do with the granting of a task or project. Callison (1998: 1) provide broader understanding of the authentic assessment, namely:

> *Authentic assessment is an evaluation process that involves multiple forms of performance measurement reflecting the student's learning, achievement, motivation, and attitudes on instructionally-relevant activities. Examples of authentic assessment techniques include performance assessment, portfolios, and self-assessment.*

O'Malley and Pierce also categorize common types of authentic assessment that must be observed and documented as follows: (a) Project / Exhibition: Students work with other students as a team to create a project that often involves the production of multimedia, oral and written presentations, and displays. (b) Experiment / Demonstration: Students documenting a series of experiments, describing the procedure, perform the steps required to complete the task, and document the results of the action. (c) Portfolio: A collection of work focused students to demonstrate progress over time. (Callinson, 1998: 2-3)

Authentic assessment can be used to measure performance, achievement, motivation, and attitude of students in relevant activities in learning. The results of the study are eligible to be used as a basis in determining the kind of authentic assessment is (Stiggins, 1994:67): students ' ability against (1) the substance of knowledge; (2) knowledge in doing the reasoning and solving problems; (3) skills in the mastery of knowledge; (4) the making of a product; and (5) achievement attitude in applying knowledge. The basic types of assessment methods offered by Stiggins (1994:83) include: (a) selected response assessment; (b) assessment essay; (c) performance assessment; and (d) personal communication assessment.

The material has different characteristics of natural sciences so not all matter natural sciences can be taught with the same method. Thus, the assessment instrument used of course will also be different, because if the instruments used are the same for all natural sciences material then there will be some aspects which cannot be measured. The selection of basic competence (KD) should be conducted to determine the appropriate type of assessment. In the development of this research material class VIII natural sciences which KD 2.4 can be used kind of an assessment portfolio. The assessment of the project can be used on a KD 3.11. with learning that directs students to solve problems by doing project work to resolve the issue. In addition, KD 3.9. can be used to measure the performance assessment science process skills students in doing the experiment.

Referring to the problems outlined, then researchers trying to develop authentic assessment instrument can measure a few skills students i.e. science process skills, critical thinking skills and problem solving skills on some of the KD in the natural sciences learning in junior high school.

II. METHODOLOGY

A. *Type of Research*

This research included in the classification of research development. The products developed in this research in the form of instrument performance assessment, portfolio and project. Research development uses a five-step development instrument non test.

B. *Research Time*

Development of instrument in authentic assessment was conducted in October 2015 until January 2016.

C. *Development Procedure*

Procedure of development following the stages of the development of non-test instrument. Stages of the development of authentic assessments include (1) determining of the instrument specification, conduct an analysis of the specification of the instrument being developed include the analysis of students, needs analysis, analysis of curriculum, selecting the shape and format of the instrument, determine the indicators, making the latticework of instruments; (2) writing the instrument,writingof authentic assessment was developed based on the lattice that have been created and then draw up the details of the statement; (3) determining the instrument scale, the scale of the instrument that was used in the development of this authentic assessment instrument in the form of scales with a scale of 1 to 4; (4) determining the scoring system, a system of scoring in this authentic assessment instrument refers to the scale of use that is the scale of 1 to 4 to the emergence of student activities provided by the observer; and (5) beating out the instrument, perform the validation material, expert assessment and teacher.

D. Data Analysis Techniques

Analysis of the validation of the content of the descriptive and quantitative basis. Quantitative analysis using Aiken's V analysis (Azwar, 2014:113) by the following formula:

$$V=\frac{\Sigma s}{n\ c-1}$$

Description:

s = r – lo
n = number of panels of assessors
lo = lowest validity assessment
c = highest validity assessment
r = the numbers given by an assessor

III. RESULTSS AND DISCUSSION

A. Procedure the development of Authentic Assessments

The products developed are authentic assessment instrument which covers the instrument performance, portfolio, and projects. The instrument used to measure the performance ofscience process skills learners in the material system for excretion. The portfolio of instruments used to measure critical thinking skills learners on the material pressure of the liquid. Project assessment instrument used to measure problem solving skills learners on optical materials on the human eye. The assessment instruments developed is in the form of sheets of observations accompanied by grating and rubric assessments. Authentic assessment instruments development procedure is as follows.

1. *Preliminary Studies*

Some of the things done on the preliminary study include: analysis of the problem, an analysis of the curriculum, and the analysis of the learners. Problem analysis was done based on interviews with a number of teachers of science in SMP N 15 Yogyakarta, SMP N 1 Piyungan, and SMP Muhamadiyah 3 Depok. The issues that emerged from the interviews that is not yet the availability of valid assessment instruments to measure skills learners, so it is important to develop these instruments. Curriculum analysis conducted to determine the competence of the basic curriculum of 2013 which corresponds to the selected material. Learner analysis aims to find out the characteristics of the students i.e. students of class VIII junior high school. Core competencies and Basic Competencies that are used in the development of authentic assessment instruments are presented in Table 1.

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TABLE 1. CORE COMPETENCIES AND BASIC COMPETENCIES

Types of Skills	Core Competencies	Basic Competencies
Science Process Skills	3. Understanding of knowledge (factual, conceptual and procedural) by curiosity about science, technology, art, cultural phenomena and events related to the visible.	3.9. Explaining the structure and function of the human excretory system and its application in maintaining personal health.
Critical Thinking Skills	3. Understanding of knowledge (factual, conceptual and procedural) by curiosity about science, technology, art, cultural phenomena and events related to the visible. 4. Rework, manage, and reasoning in the realm of the concrete (using, parse, compose, modify, and make) and the realm of the abstract (writing, reading, counting, drawing, and writing) in accordance with the learned in school and other sources in the same viewpoints / theories.	3.8. Understanding the pressure of liquids and their application in everyday life to explain the blood pressure, respiration diffusion at the event, and the osmotic pressure. 4.8 Conducting an experiment to investigate the fluid pressure at a certain depth, the buoyant force, capillarity (fluid transport in the stem of the plant), and the fluid pressure in the enclosed space.
Problem Solving Skills	3. Understanding of knowledge (factual, conceptual and procedural) by curiosity about science, technology, art, cultural phenomena and events related to the visible. 4. Rework, manage, and reasoning in the realm of the concrete (using, parse, compose, modify, and make) and the realm of the abstract (writing, reading, counting, drawing, and writing) in accordance with the learned in school and other sources in the same viewpoints / theories.	3.11. Describe the properties of light, shadow formation, as well as its application to explain human vision, and working principles optic equipments 4.11. Report the results of the investigation of the formation of a shadow on mirrors, lenses and optical instruments

2. *Determinethe Instrument's Specifications*

Science process skills indicators used in the assessment instrument are the prediction, measurement, experimentation, observation, communication, and inference. Indicators of critical thinking skills used in the instrument are a skill gives a simple explanation, generalize, infer, gave further explanations, and perform strategic steps. Indicators of problem-solving skills used in the instrument are to understand and define the problem, formulate alternative solutions, planning/define and implement a strategy, and evaluating.Indicators of each skill presented in Table 2.

TABLE 2. INDICATORS OF SCIENCE PROCESS SKILLS, CRITICAL THINKING SKILLS, AND PROBLEM SOLVING SKILLS

Types of Skills	Indicators
Science process skills	prediction, measurement, experimentation, observation, communication, and inference
Critical thinking skills	gives a simple explanation, generalize, infer, gave further explanations, and perform strategic steps
Problem-solving skills	to understand and define the problem, formulate alternative solutions, planning/define and implement a strategy, and evaluating

3. *WritingInstruments*

Writing instruments are carried out taking into account the aspect of material, construction, and language. The assessment instruments developed contain: title, usage instructions, scoring guidelines, e.g. scoring, and the observation sheet.

4. *Determinethe Scale of the Instrument and Scoring System*

The instrument was developed using a scale of 1-4. Scoring is determined in accordance with the scale used. The highest score of each indicator is 4 and the lowest is 1.

5. *ReviewingInstruments*

Authentic assessment instruments developed were investigated by seven rater.Two ratersare a matter experts and expert lecturers and five-rater else are a science teacher.

B. Results of Authentic Assessment Validation

Validation of product based on the assessment of the substance, construction, and language. Subsequent validation results are analyzed with the Aiken's V approach that aims to quantify the magnitude of the content validity coefficient (V). The magnitude of the numbers V obtained confirmed with numbers based on table Aiken's V. The minimum figure should be reached based on table V Aiken (1985:134) category 4 range and number of panel 7 are 0.86. The magnitude of V is obtained on the validation of the performance assessment sheet to measure process skills in science is about 0.86-1. The magnitude of V is obtained on the portfolio assessment sheet validation to measure critical thinking skills are of 0.98. The magnitude of V is obtained in the project assessment sheet to measure problem solving skills is of 0.86-1.

Based on the results of the analysis of the magnitude of the content validity of the assessment instrument's third showed that magnitude V instruments already exceed the minimum coefficient of Aiken's V. Thus, the assessment instruments developed meets the validity of the content. In addition to knowing the validity of the instrument developed, validation is aiming to obtain advice which can be used as material for the repair of the instrument before conducted trials at the school.

C. Revision of The Product

Assessmentinstruments are revised based on some suggestions by experts and practitioners. During limited trials and operational field test or measurement is in not discovering things that demanded he do revision, so that the revision could be made only when the process of examination of the instrument. In more detail, some revisions to the product can be outlined as follows.

1. Revisions to the usage instructions of the instrument so that more communicative and clear.
2. Revision of the observation sheet so that each observation sheets are given examples of scoring.
3. Revision of the rubrics so that homogeneous and focus on the systematic sequence.
4. Details of revision of the statement so that the statements communicated and homogeneous with other grains in one indicator.
5. Details of revision of the statement on the indicators devised the hypothesis so that made that clear parameters for measuring the skills of learners and presented grain statement about the interconnectedness between variables.
6. The revised grain statement on indicators composing the purpose of probation order made clear parameters for measuring the skills of learners and presented a statement stating the presence of grains of the verb.
7. Revision details of a statement on the observation sheet so that the language clarified.
8. Revised assertions so that the grain grain statement made clear parameters for measuring the skills of learners.
9. Revised assertions so that the grain grain statement clarified.
10. Revision of the format of the observation sheet so that there are six columns on a sheet for granting score the learners are assessed.
11. Clarify how to use observational science process skills sheet that is by adding the phrase "**give a sign check (√) in the number of students in student performance met observation of grain**" on a scoring rubric.

IV. CONCLUSION

Conclusion of this study are as follows: (1) The procedure of the authentic assessment development follows the stages of research and development. The stages include pre-survey research, problem analysis, analysis of curriculum, research studies, experts' consultation, and drafting an instrument. The stages of development include experts' validation. (2) The quality of the developed products the developed authentic assessment has a valid criterion as an instrument, in terms of aspects of the construct, substance, and language. All these aspects meet a very good criterion and can be used with revisions.

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SE – 07

Effectiveness Of Scientific Approach Integrating Onion Agriculture Potential Viewed From Secondary School Students' Environmental Care Attitude

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***Abstract*—**This study aims to analyzing the effectiveness of the implementation of scientific approach integrating onion agriculture potential viewed from secondary school student's environmental care attitude. The study was conducted quasi-experiment with nonequivalent control group design. Subject of the study consisted of 37 VII A's students as the experimental group and 36 VII B's students as a control group that was selected from nine 7th grade class at SMPN 1 Bulakamba on 1st half of the 2015/2016 school year. The data collection was done through non-test technique using a Likert scale questionnaire assessment. The effectiveness of the implementation of scientific approach integrating onion agriculture potential viewed from secondary school student's environmental care attitude was analyzed based on the average normalized gain score and independent sample t test. The results showed that the implementation of scientific approah integrating onion agriculture potential is effective in improving thestudents' environmental care attitude.

Keywords: *scientific approach, onion agriculture potential, environmental care attitude*

I. INTRODUCTION

The science learning is not only equip the students with the knowledge and skills of science, but science equip the students with scientific value to build the students' personal who have a scientific attitude. Basically, scientific attitude is an attitude of scientists when conducting scientific activities. Scientific attitude of the students is very important because it can improve students' critical to a encountered natural phenomenon and also become a benchmark level of understanding of the students [1]. Scientific attitude is very meaningful for students when interacting with the community. Students who have a scientific attitude will bring good role models when carrying out the investigations and interacting with the community [2].

One of the values and attitudes instilled in science learning is the environmental care attitude [3]. The environmental care attitude is the attitude and action which seeks to prevent and repait the surrounding environmental damage [4]. The environmental care attitude is a human effort in respecting to the environment in order to maintain the balance of life in nature [5]. Other literature mention environmental care attitude with the term sensitivity to the living and non-living environment [6, 7] and environmental attitude [8]. Environmental attitude is a learned predisposition to respond consistently favorable or unfavorable manner with respect to the environment [8].

The environmental care attitude is a reflection of the human environmental awareness. The term environmental awareness has a broad meaning. Environmental awareness is not only implies the knowledge about environment but also the values and necessary skills to solve environmental problems [9]. Roth[8] defines the environmental awareness as an important ability to feel and interpret the health level of environmental systems and to take appropriate actions in maintaining, rebuilding, or improving the health of environmental system. Environmental awareness is the characteristic of human quality to understand and know the ins and outs of working forces and conditions of the environtmen. Environmental awareness is an attitude to environment which manifests itself in terms of the awareness towards physical pollution, psychological pollution, social pollution, and cultural pollution [11].

Developing the value of environmental care attitude to students from an early age is an important efforts in environmental issues more complicated and complex. Water pollution, air pollution, hazardous and toxic waste, forests destruction, landslides, floods, loss of some biodiversity, global warming, and climate change are the serious environmental problem. Kutanegara et al.[10] states that the lack of people care to the environment role in making the environmental issues are very complicated and complex by excessive exploitation and environmentally unfriendly. Keraf [13] states that the source of environmental problems is the philosophical fundamental and human perspective error about themselves, nature, and man's place in the overall ecosystem. The perspective fallacy spawned erroneous behavior towards nature.

Keraf [13] states that the environmental problem is a moral issue and related to human behavior. Therefore, to solve environmental problems requires a improvement of ethics and morality [13]. Enterprises face the challenge of environmental problems requires a change in behavior and perpective, both as individuals and society towards social relations, cultural relations, and natural relations [13, 14]. Naess [13]reveals that today's environmental crisis can only be overcome by changing the perspective and human behavior towards nature in fundamentallly and radically. Therefore, the environmental issues resolving need the change of perspective and human behavior as individuals and as societies, the educational process can take a role in getting these changes [14]. One effort that can be done to change the perspective and human behavior toward nature through education is to inculcate environmental awareness from an early age to the students in the school.

The environmental care attitude is a part of the character building that can be developed through science learning as nurturant effect of indirect learning that occurs during the direct learning process [15, 16]. The environmental care attitude as a nurturant effect is a cumulative effect of a number of learning activities that are deliberately designed [17]. Developing of The environmental care attitude in science learning is expected to be a pattern of behavior in the students' daily lives.

The results of a preliminary study in SMP Negeri 1 Bulakamba on 1st half school year 2015/2016 show thatthe developing of environmental care attitudes to the students has been carried out by the school, but it still needs to be improved. The results of a preliminary study show that students who received a score of environmentally conscious attitudes over 70% just only 40% of all respondents. The result of a preliminary study also showed that there are still many students who do not know about the local potential around them. Thesedata shows that environmental care attitude of students in SMPN 1 Bulakamba still needs to be improved.

One effort to improve the environmentalcare attitude of students can be done by applying a scientific approach integrating contextual learning resources around students. The scientific approach emphasizes student learning activities to observe, ask, gather information, associates, and communicate. One of contextual learning resource aroud students of SMPN 1 Bulakamba is the onion agriculture potential. Onion agriculture potential is one of the main agriculture commodities of Regency Brebes. One of production center located at District Bulakamba. The use of oriented scientific approach handout by Yeni, Putra, and Hufri [18]has a significant impact on learning outcomes of cognitive, affective, and psychomotor domains. According Tarjuki [19], the implementation of scientific approach-based student worksheetwith local resources can improve the students' environmental care attitude.

Based on the advantages of the implementation of scientific approach and contextual learning resources, solving the problems of environmental care attitude of the 7th grade students of SMP Negeri 1 Bulakambacan be doneby implementing of a scientific approach-based instegrating onion agriculture potential. Implementation of a scientific approach integrating oinion agricultuel potential includes the activities of observing, guestioning,gathering information to solve the question, associating, and communicating the information[20]. observing, questioning, gather information or experimenting, associating, and communicating the information. On observing activities, the student are asked to observe the onion agricultural potential as science object. For example, observing the onion on polybag or observing the onions field. Based on the observations activites, the students were asked to formulate questions. In this case, the teacher needs to facilitate students to formulate questions that lead to learning objectives to be achieved. After the students formulate questions, the teacher facilitates students to gather information, associate information, and communicate the obtained information.

This study aims to analyzing the effectiveness of the implementation of scientific approach integrating onion agriculture potential viewed from secondary school student's environmental care attitude. The success of the developing environmental care attitude can be assessed the student using some indicators. The indicators of environmental care attitude considered in this study is (1) pay attention to the local environment; (2) participate in social activities; (2) pay attention to health;(3) pay attention to the family;(4) maintain cleanliness; (5) not burn trash; (6) not take, cut or revoke plants located along the way; (7) not cross out or incise the inscription on the trees, rocks, roads or walls; and (8) keep always preserving the environment.

II. RESEARCH METHOD

The study was conducted on October until November 2015 at SMPN 1 Bulakamba. The study was conducted by using quasi-experiment with nonequivalent control group design[21]that modified. The subject of this study are class VII A and class VII B that selected from nine 7th grade class of SMPN 1 Bulakamba. Determination of the experimental group and the control group was done randomly with the results class VII A as the experimental group and class VII B as the control group.The selected experimental group and control group were preceded by pre-test. In the latter part the selected students groups weregiven the post-test.The reseacrh design is shown in Figure 1.

Experimental Group	O_1	X	O_2
Control Group	O_1	Y	O_2

FIGURE 1.RESEACH DESIGN[21]

Remarks:
X = implementation of scientific approach-based integrating onion agriculture potential
Y = implementation of learning approach non integrating onion agriculture potential
O_1 = pre-test
O_2 = post-test

The data collection was done through non-test techniques using questionnaire of students' environmental care attitude. The questionnaire was drafted in the form of Likert scale questionnaire with four option (1 = strongly agree, 2 = agree, 3 = disagree, and 4 = strongly disagree). Item ratings in the questionnaire consists of 10 positive statements and 10 negative statements. The option score for the positive and negative statements are presented in Table 1.

TABLE 1.THE SCOREOF QUESTIONNAIRE OPTION

Option	**Score**	
	Positive Statements	**Negative Statements**
1	4	1
2	3	2
3	2	3
4	1	4

The effectiveness of the implementation of scientific approach integrating onion agriculture potential viewed from secondary school student's environmental care attitude was analyzed based on the average normalized gain score and independent sample t test. The average normalized gain score is obtained by the following equation.

$$g \quad \frac{post \quad - \quad pre}{- \quad pre}$$

remarks:
<g> = the average gain score normalized
<%*post*> = the final class score percentage averages
<%*pre*> = the initial class score percentage averages [22].

The obtain average normalized gain score is consulted to three categories, i.e: (1) high with $<g> \geq 0.7$; (2) medium with $0.3 \leq <g> < 0.7$; and (3) low with $<g> < 0.3$ [23].

The independent samples t test is used to analyze statistically significant difference between students' environmental care attitude in experimental group and control group. The analyzed data samples are the single-student normalized gain scores that's obtained by the following equation.

$$g \quad \frac{postscore \quad - prescore}{- \quad prescore}$$

remarks:
g = the single-student normalized gain score
postscore% = the finalsingle-student score percentage
prescore% = the initialsingle-student score percentage[24].

The testing of assumptions analysis before committing independent t-test consist of normality and homogeneity of variance. The normality of data samples istested by the Kolmogorov-Smirnov test using SPSS version 22 at significance level 0.05. The hypothesis of tested data samples normality is: the data sample comes from a normally distributed population. The hypothesis will be acceptedif the value of sig. ≥05. The homogeneity of variance between two groups data samples is tested by Lavene's Test using SPSS version 22. The hypothesis of homogeneity is:the varianacebetween two groups is homogeneous.The hypothesis will be acceptedif the value of sig. ≥05.

The hypothesis of is stated bellow.

H_0: $\mu_1 \quad \mu_2$
H_1: $\mu_1 = \mu_2$

Remarks:
H_0 = there is not statistically significant difference between students' environmental care attitude in experimental group and control group
H_1= there is statistically significant difference between students' environmental care attitude in experimental group and control group
The hypothesisobove is tested at significance level 0.05 using SPSS version 22. The decision crtieria are: H_0 will be acceepted if the value of sig. $\geq$0.05 or H_0 will be rejected if the value of sig. <0.05.

III. RESULT AND DISCISSION

The summary of pre-test and post-test result of the students' environmental care attitude are presented in Table 2.

TABLE 2.THE SUMMARY OF PRE-TEST AND POST-TEST RESULT OFTHE STUDENTS' ENVIRONMENTAL CARE ATTITUDE

	Experimental Group		Control Group	
	prescore%	*postscore%*	*prescore%*	*postscore%*
The number of student	37	37	36	36
Average	73.58	85.34	70.31	78.99
Highest score	90	98.75	80.00	92.50
Lowest score	63.75	66.25	51.25	65.00
Variance	41.42	58.56	49.41	58.56
Standard Deviation	6.44	7.65	7.03	7.65

Based on Table 2 it can be seen that the average of final score in experimental group and control group are higher than the average of final score. It means that the students' environmental care attitude in the experimental group and control group have increased. Based on the results of the average normalized gain score analysis, the improvement of students' environmental care attitude in the experimental group is in the medium category with <g> = 0.45 and in the control group is in the low category with <g> = 0,29 (Tabel 3). Based on the value of <g>, the improvement of students' environmental care attitude in experimental group is higher than control group. It means, based on the results of the average normalized gain score analysis show that implementation of scientific approach-based integrating onion agriculture potential is more effective than implementation of learning approach not integrating with onion agriculture potential.

TABLE 3.THE RESULTS OFTHE AVERAGE NORMALIZED GAIN SCORE ANALYSIS

	<%*pre*>	<%*post*>	<*g*>	Category
Experimental Group	73.58	85.34	0.45	Medium
Control Group	70.31	78.99	0.29	Low

The comparison of effectiveness difference between theimplementation of scientific approach-based integrating onion agriculture potential and the implementation of learning approach non integrating onion agriculture potential were statistically analyzed by using independent samples t testto the single-student normalized gain score. The testing of assumptions analysis before committing independent samples t test consist of normality and homogeneity of variance. The normality of data samples is tested by the Kolmogorov-Smirnov test using SPSS version 22 at significance level 0.05.The result of Kolmogorov-Smirnov test in two group scores are presented in Table 4. Based on Table 4 it can be seen that the significant value of the Kolmogorov-Smirnov test in experimental group and control group are more than 0.05.So, the hypothesis that's states the data sample comes from a normally distributed population is accepted. It means that each data sample in experimental group and control group come from a normally distributed population.

TABLE 4.THE RESULT OF KOLMOGOROV-SMIRNOV TEST

	Test	Sig.
Experimental Group	Kolmogorov-Smirnov	0.200
Control Group	Kolmogorov-Smirnov	0.200

The homogeneity of varianceis tested by Lavene's Testusing SPSS 22 version at a significance level of 0.05. The Levene's Test generate the value sig.= 0.44 $\geq$ 0.05. So, the hypothesis that's states the variance between two groups is homogeneous is accepted. It means the variance between two groups is homogeneous.

The results of assumption test show that the data sample fulfill the assumptions of normality and homogeneity of variance, so it can be tested by independent samples t test. The result of independent sample t test to the single-student normalized gain score of the the students' environmental care attitudecan be seen in Table 5.

TABLE 5.THE RESULT OF INDEPENDENT SAMPLE T TEST

t	df	Mean Difference	Sig. (2-tailed)
3.154	71	0.16424	0.002

Based on Table 5, the result of independent samples t testto the single-student normalized gain score of students' environmental care attitude generate sig. 0.002. Because the generated sig. value is lower than 0.05, the H_0 is rejected. It means, there is statistically significant difference between students' environmental care attitude in experimental group and control group. So, based on independent samples t testto the single-student normalized gain score at significance level 0.05, theimplementation of scientific approach-based integrating onion agriculture potential is effective in improving the student's environmental care attitude.

IV. CONCLUSION AND SUGGESTION

Based on the study results and discussion can be concluded that the implementation of scientific approach integrating onion agriculture potential is effective in improving the students' environmental care attitude.

The subject matter raised in this study is limited to the **science object and observations(Objek IPA dan Pengamatannya)**. Therefore, it is necessary to conduct further research to gain the advantages of the implementation scientific approach integrating onion agriculture potenstial on the other subject matter and student competences.

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SE – 08

Activism of The Students in Reflective Thinking Learning Method with Brainstorming and Oriented in Question

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Abstract— The purpose of this research is to know and compare activism of the college students after they implemented Reflective Thinking learning method with an appproachment that oriented in question and brainstorming in Basic Natural Science. The method of this research is quasi experimental. The sample of this research is college students of Ahmad Dahlan University in second semester of the 2014/2015 school year that were learning Basic Natural Science. The research was done in two classes, wich in each class was given a learning with Reflective Thinking. Class A with an appproachment that oriented in questions and class B with brainstorming. Observation was done to know activism of the college students. Based on research, we could conclude that the activism level of the students in Reflective Thinking learning method with an appproachment brainstorming is higher than the activism level of the students with an appproachment that oriented in question.

Keywords: *Reflective Thinking, activism, brainstorming*

I. INTRODUCTION

In following Basic Natural Sciences lecture, students of Ahmad Dahlan University tend not to be quite active. They only had a little discussion, listening and partly wrote what the lecturer's said. While the learning method that the lecturer uses was a speech with the help of power point presentation.

When people think about transfer, it is common to think first about learning something and then assessing the learner's abilities to apply it to something else [1]. But even the initial learning phase involves transfer because it is based on the knowledge that people bring to any learning situation. Teaching is more than telling [2]. Effective teaching requires a great deal of thought, preparation, and design. The analysis of the teaching process includes six elements, as in [3], these are:

1. Identification of potential learners, estimating their requirements and breaking the ice.
2. Creation, selection, and preparation of tasks, experiences, and activities.
3. Preparation of resources.
4. Performance of tasks, roles, and responsibilities.
5. Assesment and feedback on learning.
6. Evaluation and reviewing of teaching.

Activities consist of two things which are physic activity and mental activity. Student activity in learning is very important. Both are a unity that cannot be separated. The materials will be easy to understand when students are active in learning. So the more active the student, the better the learning will be. Various student activities in learning are:

1. Visual activity (e.g. reading, watching demonstration pictures, experiment, watching other's work).
2. Oral activities (e.g. explaining, formulating, asking, giving suggestion, having a notion, holding interview, discussion).
3. Listening activities (e.g. listening conversations, discussion, music, speech).
4. Writing activities (e.g. story-writing, opus-making, report, inquiry, duplicating).
5. Drawing activities (e.g. drawing, graph-making, map, diagram)
6. Motor activities (e.g. experiment, construction-building, playing).
7. Mental activities (e.g. responding, remembering, problem-solving, analyzing, decision-making).
8. Emotional activities (e.g. put an interest, feeling bored, happy, excited, enthusiast, calm).

Reflective thinking is a part from the research method which was told by John Dewey. In fact, he defined the educational process as a continual reorganization, reconstruction and transformation of experience [4]. His opinion as in [5]: Education is a social process where people who hasn't been mature (especially children) is invited to socialize with people. The education purpose is giving a contribution in self and social development through experience and problem-solving which goes on reflectively (reflective thinking). According to John

Dewey, reflective thinking in problem-solving is a process of active-thinking, carefulness, which based on thinking process aimed on five-step-definitive conclusions, which are:

1. Students recognize problems that come outside the student's self.
2. Students will investigate and analyze the difficulty and determine the problem they face.
3. Students connect the analysis results or one another and collect the hypothesis to solve the problem. Students do it on their experience guidance.
4. Students consider the possible answers or hypothesis with each cause.
5. Students try to practice one of the possible answer which they consider as the best. The result will proof whether it is right or wrong. If it is wrong, then they will try the other answer until they find the exact problem solving.

John Dewey told that the thinking process goes these steps below:

1. The felt need
2. The problem
3. The hypothesis
4. Collection of data as evidence
5. Concluding belief
6. General value of the conclusion

Problem solving method in reflective thinking can be gotten from many ways. Such as brainstorming and question-oriented approach. Brainstorming method is also known as giving suggestions.

Brainstorming method is a discussion form to collect opinions, arguments, informations, knowledges, experiences from all participants. On brainstorming method, other person's opinion is not to be responded. This method base on argument that some people are possible to have more opinions than others. In brainstorming, will be served a problem, then participants are invited to propose any idea about it, no matter how strange it is. Strange ideas are not priori rejected, but analyzed, synthesized and also evaluated. There may come the unexpected problem solving.

Question-oriented approach needs group to consider series of questions in order to still have orientation on their purpose. Questions in this approach are arranged to help the group identifies important issues that will be solved. Besides, those questions can also make the group formulating the best solution that can be done.

II. RESEARCH METHOD

This research method is quasi experimental. There are two classes in this research, class A as experiment class and class B as control class. In class A, students have the reflective thinking kind of learning with question-oriented approach, while class B has brainstorming learning.

TABEL 1. REFLECTIVE THINKING RESEARCH DESIGN

Class	Treatment	Activity
A	Question-oriented	V
B	Brainstorming	V

The data sample in this research are students of Ahmad Dahlan University in 2014/2015 period in even semester who were majoring Basic Natural Sciences on class A and class B. This observation was done during the learning process to know the student's activity. Class A observation result will be compared to class B observation result to know which class has more active student. Student activity observation paper is arranged with Likert scale as:

TABEL 2. STUDENT ACTIVITY OBSERVATION SCALE

score	Activity
1	Inactive
2	Less active
3	Active
4	Very Active

The success percentage (SP) of student activity can be counted with this formula below:

$$SP = \frac{obtained\ score}{maximum\ score} \text{ x } 100\% \tag{1}$$

III. THE RESEARCH RESULT AND EXPLAINATION

The reflective thinking learning was given on each class A and class B three sessions. The material that was given was scientific method and the technology impact. Class A with question-oriented approach while class B with brainstorming approach. During the learning process an observation was done to the students' activity. The results of the students' activity observation can be drawn into this table below:

TABEL 3. ACTIVITY OF STUDENTS IN CLASS A (WITH QUESTION-ORIENTED APPROACH)

Number	**Activity indicator**	**1st sess. score**	**2nd sess. score**	**3rd sess. score**	**Average score**
1.	Active on giving opinion	19	21	22	20,7
2.	Active on asking	15	17	18	16,7
3.	Active on responding	17	19	19	18,3
4.	Listening to friend's opinion carefully	22	23	23	22,7
5.	Giving chance to friends for responding/asking	19	20	20	19,7
6.	Answering friend's question correctly	23	23	23	23
7.	Report-writing	30	30	30	30
	Average	20,7	21,9	22,1	26,5

TABEL 4. ACTIVITY OF STUDENTS IN CLASS B (WITH BRAINSTORMING APPROACH)

Number	**Activity indicator**	**1st sess. score**	**2nd sess. score**	**3rd sess. score**	**Average score**
1.	Active on giving opinion	35	35	35	35
2.	Active on asking	36	36	36	36
3.	Active on responding	36	36	36	36
4.	Listening to friend's opinion carefully	29	30	30	29,7
5.	Giving chance to friends for responding/asking	30	31	32	31
6.	Answering friend's question correctly	28	30	31	29,7
7.	Report-writing	31	31	31	31
	Average	32,1	32,7	33	33,8

If it is drawn in graph, then the observation data of average student activity in class A and class B can be seen below:

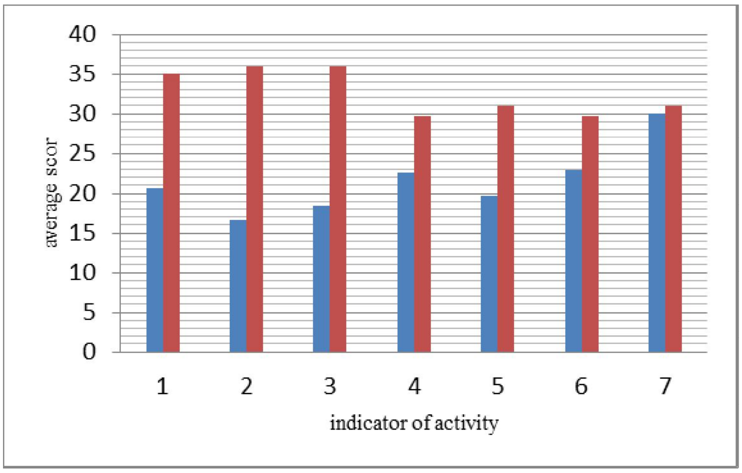

FIGURE 1. GRAPH OF STUDENT ACTIVITY OBSERVATION RESULT ON CLASS A AND CLASS B

The success percentage of student activity on class A can be calculated as:

$$\text{Success Percentage on Class A (SPA)} = \frac{total\ obtained\ score}{total\ maximum\ score} \times 100\%$$

$$\text{SPA} = \frac{26\ 5}{40} \times 100\% = 66.25\%$$

The success percentage of students' activity on class B can be calculated as:

$$\text{Success Percentage on Class B (SPB)} = \frac{total\ obtained\ score}{total\ maximum\ score}\ \text{x}\ 100\%$$

$$\text{SPB} = \frac{33\ 8}{40}\ \text{x}\ 100\% = 84.5\%$$

Based on Success Percentage calculation above, then could be compared that student in class B had a higher Success percentage compared to class A. So students who did reflective thinking with brainstorming method were tend to be more active that students who did reflective thinking with question-oriented method.

In class A (question-oriented) students were less active, compared to class B (brainstorming). This happened because when discussion was directed with question, students were rived on those questions, which meant that their ideas were limited. Finally, some of them only chatted with their friends outside the discussion topic. Only few students from the group who looked seriously discussed those questions. So that, the discussion's situation would feel strained and be less active. Unlike the brainstorming's situation. Students were not limited with list of questions when they had a discussion. Even more, each student must tell all of his ideas to the group. The ideas were unlimited and none was able to comment or criticize all of the ideas that had been told. Therefore, all students were involved actively in discussion. Even more, in brainstorming, students were timeless and the learning felt defiant and fun. The group's conclusion was the summary of all ideas that were told by students.

IV. CLOSING

Based on the research result, there is obtained a conclusion that on reflective thinking learning, student's activity who applied brainstorming method was higher than the question-oriented method. In applying the reflective thinking learning method, time setting is very important in order to get an effective and efficient discussion. Besides, students have to do a preparation before the learning that is understand the materials in order to get an active and aimed discussion.

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SE – 09

Development The Subject Specific Pedagogy (SSP) of Natural Science to Optimize Mastery Knowledge, Attitude, and Skills Junior High School Students in Yogyakarta

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Abstract— Research development in the 1th year aim to develop the Natural Science's SSP for JHS students that can used as a reference for natural science learning activities, so can optimize the mastery of knowledge, attitude, and skills students. The design of the study is a developmental research from Borg and Gall with 10-step. In the first year only managed to reach the design stage and instrument SSP. The instruments for collecting data are validity of products; test to measure the achievement aspects of knowledge, observation sheets to measure the aspects of skills and attitudes, as well as a questionnaire to measure the aspects of attitude. The results of the study are generated 8 package Natural Science SSP JHS for materials: 1) change of substance; 2) acid, base, and salt; 3) expansion; 4) the structure and function of the network; 5) photosynthesis; 6) the digestive system of food; 7) survival; 8) dynamic power. The result of the development of instruments includes instrument validation 1) syllabus; 2) RPP; 3) LKS; and 4) assessment. While SSP ratings include 1) aspects of test for knowledge; 2) non-test for aspects of attitude; and 3) test the performance aspect skills.

Keywords: *Science SSP, knowledge, attitude, skiils*

I. INTRODUCTION

The success of science teaching in junior high school (JHS) is strongly influenced by the learning design that conduct in class. Mastery of teacher's competence in science as a whole will determine the success of science learning. Based on UU No. 14 tahun 2005 Tentang Guru dan Dosen, pasal 10, ayat (1), states that: the teachers 'competency includes: pedagogical, personal, social, and professional competence acquired through professional education. When teacher mastery four of competencies, will create a learning design as expected. The successful learning depending on standard design learning that conducted was the obtaining of the success of learners after participating in learning activities is the form acquisition of knowledge, attitude and skills.

Based on the results of the discussion with colleagues in MGMP of Yogyakarta, there are still a lot of complaints when the science teacher should taught integrated science. A Science teacher that currently exists is the incarnation of specific scientific disciplines such as physics, biology, and chemistry. Science teachers that already exists with diverse disciplines must adapt to science teaching is carried out in an integrated manner. Under these conditions, the ability of a science teacher who is currently on average have not been able to prepare the design of learning science as a whole, so that the implementation cannot be accommodated it well.

Those problems can be overcome with the help of the science teachers SMP Yogyakarta to prepare design of learning is good and right, which is expected to broaden the teachers, thus more capable of learning design, especially the areas of integrated IPA yet secured. Handayani (2014) stated, that the implementation of learning requires a special component known as Subject Specific Pedagogy (SSP). SSP is a result of the teachers' thoughts contained in the components of learning. SSP components, among others: (1) the syllabus; (2) Learning Implementation Plan (RPP); (3) The student Worksheet (LKS); and (4) assessment.
Based on this background, the researchers will develop SSP required for SMP teachers Yogyakarta so can be used to overcome these problems. As for the development in question is Subject Specific Pedagogy (SSP) IPA for optimizing mastery of Knowledge, Attitude and Skill of Students SMP Yogyakarta. This study aimed to describe the Science's SSP as a benchmark development activities science teaching junior high school in the city of Yogyakarta in order to optimize the mastery of knowledge, attitude, and skills.

II. THEORITICAL REVIEW

Subject Specific Pedagogy (SSP)

The characters of Subject Specific Pedagogy (SSP) are a packaging of study material into a comprehensive set of learning and educating. SSP consists of five basic components, namely the syllabus, lesson plans, student books, worksheets, and assessment. Has not provided a learning tool as SSP in SHS that integrated with the knowledge, skills and attitudes / values of the characters, so the natural science's SSP should be developed.

Preparation of natural science teachers that master of the content and methods of delivery (teaching) for students, known as Approach PCK (*Pedagogical Content Knowledge*). PCK provides a basis to think that the teaching of natural science is not enough with understand content material (knowing science) but also (how to teach). Natural science's teachers must have knowledge of science learners, curriculum, instructional strategies, and assessment so that can carry out the transformation of natural science knowledge. Some grounding in the underlying need to develop instructions on natural science education based PCK.

The study is required to determine the characteristics of natural science education with content knowledge, skill and affective. In the PPG curriculum 2014, learning field of study that educate subject-specific pedagogy (SSP) includes the development of learning tools (teaching materials, methods, media, evaluation and RPP) corresponding KI and KD in SHS and according to the level of the class.

According to an article from a university in Illinois, to teach the natural science for students, teachers need Pedagogical Sciences (PS). PS including an understanding of the content of science and inquiry process, knowledge about children, how children learn, and skills to facilitate experiences of children in a way that supports active investigation and conceptual development. Furthermore, a program designed to build PS's teacher PS is Foundation Science Literacy (FSL). This course combines face-to-face instruction with mentoring and tasks based of performance. FSL incorporate six key elements proved instrumental in supporting teacher learning: (1) approach to science teaching based inquiry well-defined and well structured, (2) the content of the science carefully selected, (3) hands-on, approach learning based the teachers themselves and inquiry, (4) the opportunity to apply new learning through analysis, (5) tasks based on performance, and (6) mentoring

According to Adela Solis in article of INDRA, Pedagogical Sciences, core of area Pedagogical Content Knowledge Area, PCK describe that make the difficult topic can easy to learn. To teach all of students in accordance with current standards, teachers do need to understand the subject matter deeply and flexibly so they can help students map out their ideas themselves, relate one idea to another, and re-direct their thinking to create a powerful learning. Teachers also need to see how ideas connect across the field and everyday life. It is the building block of pedagogical content knowledge.

This is important, because after all, pedagogical content knowledge has become a special subject. How PCK example in the core subject areas of language, science, mathematics and social sciences. How this knowledge compared with other knowledge of the teachers? Comparative view of teaching standards shows different expectations with regard to teaching content knowledge, pedagogical knowledge of general and pedagogical content knowledge (NBPTS, 1998). Standards are organized in this way is a ready-made guide for practitioners to use in directing specific learning content teachers. Furthermore, these differences in the knowledge base can be used to assess the planning and implementation of professional development of teachers overall content.

Briefly stated that the central content of effective teaching is pedagogical content knowledge of teachers. If we want to improve the quality of teaching and learning in the core content, we need to fight some old tradition in learning. Instead, we must recognize and expand the horizons of experts who develop competencies in teaching the subject matter. We must have a commitment to the development of professional, high quality targeted to develop these skills. When we do this, we support the growth of teachers as a personal and professional experts can lead students to academic success. Simultaneously, we will contribute to the realization of the objectives and priorities of the classroom and the school system as a whole. We need to discuss how the general knowledge of PC juxtaposed with diverse pedagogical knowledge to be applied in a training program that addresses the needs of teachers in the classroom with diverse student populations.

Optimal

According to Indonesian dictionary online, Optimal has the meaning the best, the highest, most profitable. Optimizing have meaning makes the best or highest. Understanding optimization according to the Dictionary of Indonesian Language (Departemen Pendidikan, 1995: 628) is derived from the optimization of the optimal word which means the best, the highest so optimization is a process or optimize elevate or boost.

Based on the above understanding, authors conclude optimize is a process that is done in the best way in a job to earn a profit without decreasing the quality of work. In this case the SSP product could optimize mastery of knowledge, attitude and skills of learners.

Knowledge, Attitude, dan Skill

Karmilati (2012) states that knowledge, attitude, and skill have the following definitions: knowledge is a condition/conclusion or information that describing knowledge after receiving information compared with prior knowledge owned. The knowledge of the person can be grouped into three categories: (1) declarative knowledge is factual information on a subject that is stored in one's memory. (2) Procedural Knowledge is one's understanding about how and when to use factual information. (3) Knowledge Strategy is knowledge of the facts and procedures used to plan, monitor and revise the direction of the planned objectives.

The level of competence of a person is determined by its attitude, which will determine how to behave in a certain way on an object events. Experts argue that human is not born with attitude, they obtained attitude from the series process of lessons from childhood to adulthood. Attitude involves the evaluation of the issues over the object or event that is perceived and observed, and put the person in a particular behavior.

Many experts argue that individual knowledge should not be as a result of their skill, but skill is evidence of the knowledge. Skill is the result of apply their knowledge and abilities. Skill is a talent and learned person to do a job. Skill will change with training or experienced. Skill divided into three: (1) a Cognitive skill are the ability to view and analyze the events and observe the important truth, critical thinking skills to analyze future events and is able to be proactive). (2) Psychomotor skills are skills that involve the ability to perform physical tasks or technical. (3) Interpersonal skills are personal interaction skills involves the ability to cooperate with others.

III. METHODOLOGY

This study will be conducted in SMP Yogyakarta that will be determined randomly from 8 schools (SMP Pangudi Luhur 1 Yogyakarta, SMPN 10, SMPN 4, SMPN 12, SMP Imaculata Yogyakarta, SMP Muhammadiyah 1 Yogyakarta, SMP Negeri 7, and MTs Mualimin Yogyakarta) and the time of the research carried out at the end of the 1th semester 2015 (1 June 2015 - 31 November 2015). This research will develop SSP of natural science JHS to optimize mastery of knowledge, attitude and skills of learners in Yogyakarta.

Types of research

The design of the study is a developmental research. According to Borg and Gall. Educational research and development (R & D) or educational research and development is a process used to develop and validate a product of education. This research shaped cycle of repetition of steps to produce and test the effectiveness of the products through the validation and testing.

The study design used for field testing of product is randomized pretest-posttest control group design and can be seen in the Figure1.

Group	Pretest	Treatment	Postest
KE	O1	X	O2
KK	O3	-	O4

FIGURE 1. DESIGN FIELD TESTING OF PRODUCT

Subject of the Research

Subject of the research were students of class VII, VIII, IX SMP city of Yogyakarta in the academic year 2015/2016. While the study sample was taken 6 class at random from the population as experimental class and control class in the field tests of the products developed.

Model and Research Procedure

According to Borg and Gall, there are 10 steps in the procedure development, that is:

a. Research and information collecting (research and data collection)
b. Planning
c. Develop a preliminary form of the product (draft product development / product early)
d. Preliminary field testing (field trials beginning)
e. Main product revision (revising the test results)
f. Main field testing (field trials)
g. Operational product revision (improvement of products, field test results)
h. Operational field testing (test field implementation)
i. Final product revision (improvement of the final product)
j. Dissemination and implementation (dissemination and implementation)

Model and procedures development in this study modified into 5 steps as follows:

The first year

a. Preliminary study: analysis of materials science class VII, VIII, IX and analysis of the results of the 1st half of the space research observation and condition / situation.

b. Design: syllabus, lesson plans, teaching materials, and models of CNS.

The second year

c. Stage of development: expert validation , revision, peers assessment, friends teachers, revision

d. The implementation stage: limited trial, revisi expanded ,field testing, revision, final product.

The third years

e. Dissemination of product

Design evaluation and assessment products: using instruments for validator and instrument for assessors. Subject validation and assessors: Experts/evaluator, student friends/other teachers of the school, a school teacher friend. Design test: product trials conducted twice, limited testing and field tests using the experimental group and the control group. Instrument: validation instrument, and the instrument for which data is collected

Data were collected with:

1. Pretest and average pretest results are used to determine the grade used as an experimental class and control class.
2. From the class samples, performed treatment using the SSP that had been prepared for learning material that has been determined based on the time of data collection.
3. During treatment and after treatment is given taken the assessment data that includes knowledge, attitude, and skills to students who are in the experimental class and control class.

The instruments are needed in data collection that is: Validation of early product SSP; Instruments of the result preliminary fiels testing; Revised Instrument of Products; Instrument of field testing; Pretest; Data recap pretest; Instrument assessment aspect attitude; Posttest; Data recap posttest.

IV. RESULTS AND DISCUSSION

Results from the design stage which includes a variety of materials, models, products, and dimensions of learning outcomes are presented Table 1.

TABLE 1. LIST OF SSP COVERAGE DESIGN RESULTS

Number	Materials	Model	Product	Knowledge	Attitude	Skills
1	Photosynthesis	Contekstual Teaching and Learning	Syllabus, lesson plans, worksheets, assessment	Learning achievement	Discipline	Observation skills
2	Structure and Function of Plants Network	Guided Discovery	Syllabus, lesson plans, worksheets, assessment	Cognitive competence	conscientious	psychomotor
3	Substance Changes	Discovery Learning	Syllabus, lesson plans, worksheets, assessment	Learning achievement	environment respect	Problem solving
4	Acids, bases and salts	Guided Inquiry	Syllabus, lesson plans, worksheets, assessment	Comprehension	curiosity	Science process skills
5	Digestive system	Discovery Learning	Syllabus, lesson plans, worksheets, assessment	Cognitive competence	curiosity	Scientific Methods
6	Survival (Adaptation)	Problem Based Learning	Syllabus, lesson plans, worksheets, assessment	Cognitive product	environment respect	Problem solving
7	Expansion	Lab Work	Syllabus, lesson plans, worksheets, assessment	Cognitive product	creative	Practical Skills
8	Dynamic electricity	Lab Work	Syllabus, lesson plans, worksheets, assessment	Learning achievement	curiosity	Science process skills

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TABLE 2. DESCRIPTION OF MULTIPLE REVISIONS BASED FGD PRODUCT SSP SSP 1 AND 2

		SSP 1
Syllabus	:	ligning components on the syllabus of learning activities, indicators, assessment.
Lesson Plan	:	Revise the words operational work more precisely Add the image number numbering equation On learning activities need to be specified stages of lab work
Student Worksheet	:	On the tools and materials need to be specified using the numbering. Writing the equation in italics.
assessment	:	In the multiple choice test is still there such as "look at the picture above, was revised to look at the picture on the side. Writing items that contain elements symbol in italics Between the attitude and curiosity should be detailed Need to explain every aspect of the lab work.
		SSP 2
Syllabus	:	Writing SK, KD straightened The learning activities in accordance with contextual learning Competence achievement indicator is assigned a value SK 2, KD: 2.2 Indicators: 2.2.1, and so on.
Lesson Plan	:	Writing SK and KD. **2.** Understand system in the plant life. 2.2. Describe transformation process of acquiring nutrients and energy in green plants Competence achievement indicator is assigned a value SK 2, KD: 2.2 Indicators: 2.2.1, and so on. Revision of the typing learning materials (no.1-4) Learning preliminary steps there is motivation, apperception.e. Core activities appropriate contextual learning
Student Worksheet	:	Layout LKS made interesting
Assessment	:	Remove the statement questionnaire no 19-21 Observation skills performed on process pick-test learning the work of LKS

TABLE 3. DESCRIPTION OF SEVERAL REVISIONS BASED FGD PRODUCT SSP 3 AND 4

		SSP 3
Syllabus	:	On learning activity comes with a description of integration of spiritual and social attitudes
Lesson Plan	:	The core activity describe the scientific approach and discovery learning
Student Worksheet	:	Student worksheet shows activity in stage 5M
Assessment	:	Revision of test cognitive competence For instruments scientific competence improved method to be equipped with pick-test assessment scores work according to the stages in LKPD.
		SSP 4
Syllabus	:	Systematics characteristics lab work sorted logically Sentence created a line fot KD, subject matter, learning activities, indicator, and instruments Written sources such as a bibliography Indicators are sorted according to the characteristics of systematic lab work
Lesson Plan	:	Core activities adjusted for lab work Methodsof learning just lab work Writing source in accordance with the guidelines
Student Worksheet	:	Sentences on the work steps create a short, not too long The variable is replaced by a factor The identification of problems
Assessment	:	Problem corrected to conform to the lab work Instrument repaired on the score Instruments be adapted to the practical skills

TABEL 4. DESKRIPSI BEBERAPA REVISI PRODUK SSP BERDASAR FGD SSP 5 DAN 6

		SSP 5
Syllabus	:	<u>Instrument Validation:</u> On Teaching and Learning, the instrument should focus on Guided Discovery Model, described syntax. <u>Product Syllabus:</u> At the Learning Activities are explicit guided discovery
Lesson Plan	:	<u>Instrument Validation:</u> learning activities refer syntax of guiden discovery
Student Worksheet	:	<u>Instrument Validation:</u> Guided Discovery components are described as on lesson plan: Stimulus Problem statement Data Collection Data Processing

		Verification Generalization
Assessment	:	Make the kisi-kisi of assesment
		SSP 6
Syllabus	:	On Teaching and Learning, the instrument should focus on Discovery Learning Model, described syntax.
Lesson Plan	:	Learning resources to load different types of books, authors, year of publication, pages.
Student Worksheet	:	Step Problem solving is separated from LKS.
Assessment	:	revision of some indicators oassesmentf

TABLE 5. DESCRIPTION OF SOME REVISIONS BASED FGD PRODUCTS SSP 7 AND 8

		SSP 7
Syllabus	:	Learning activities refers syntax PBL 1) Determine the Problem 2) Analysis of Learning Problems and Issues 3) Meetings and Reports 4) Presentation Solutions and Reflection 5) Conclusion, Integration, Evaluation
Lesson Plan	:	Teacher and Student Activity clarified Map concept of the material survival equipped
Student Worksheet	:	Made more attractive, font changed The verb shortened
Assessment	:	Problem Formulation 1, 4, and 23 repaired Distractor question no 2 and 3 fixed Formulation of about 2, 3 and 4 rep

Results of FGD used as input material revisions or improvements SSP, in order to obtain a revised SSP. Revised SSP will be validated on experts and practitioners, as well as tested in the study in 2th year.

V. CONCLUSIONS AND FOLLOW UP

Based on the results of the 1th year of the research in the first year, it can be concluded as follows. The design phase is based on preliminary studies, it produced 8 SSP package IPA for class VII, VIII, and IX. Components of SSP include syllabi, lesson plans, worksheets, and assessments. 8 package that has been designed SSP presented in a focus group discussion, so get input for the revision material of SSP natural science SSP. As a follow-up to the design stage, it will proceed the 2th year study in the second form of validation experts and practitioners IPA SSP design and limited test results

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SE – 10

Developing Computer-Based Instructional Media on Sound Wave and Hearing Topics to Improve Learning Outcomes in Observing, Questioning, Collecting, Associating or Analyzing, and Communicating Information

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Abstract**—**The aim of the study is to describe the improvement of students' learning outcomes in observing, questioning, collecting, associating or analyzing, and communicating information after utilizing developed media. This study was categorized as a Research and Development (R&D) design adapted from Borg & Gall models. It consisted of five stages: (1) need assessment, (2) instructional design, (3) media development, (4) validation, revision and product testing, and (5) dissemination. Instruments for collecting the data were validation questionnaires and pre-test and post-test question sheets to measure students' aspects of observing, questioning, collecting, associating or analyzing, and communicating information on sound wave and hearing topics. Learning outcomes measurement on aspects of observing, questioning, collecting, associating or analyzing, and communicating information of 8th grade students of SMPIT Alam Nurul Islam were administered using one-group pre-test and post-test experiment design and analyzed by using gain score analysis. The results of the process are computer-based instructional media on sound wave and hearing topics. The conclusions of this study is the use of the media improves students' learning outcomes in observing, questioning, and collecting, associating or analyzing, and communicating information skills. It is shown on the gain score difference which is 0.56 categorized as "medium".

Keywords: *instructional media, sound wave, hearing, learning outcomes*

I. INTRODUCTION

Kurikulum 2013 is one of the referenced curriculum of learning in Indonesia. The learning process developed in Kurikulum 2013 includes educational process in which students develop the knowledge, thinking skills, and psychomotor skills through interaction with learning resources. In this study, the ability of 5M which consists of the ability to observe (*mengobservasi)*, ask (*menanya)*, gather information (*mengumpulkan informasi)*, associates or analyze (*mengasosiasi / menganalisis)*, and communicate what was found through analysis developed by students *(mengkomunikasikan)*. Science is a subject which is composed of four branches of science, namely chemistry, physics, biology, and earth and space sciences. Kurikulum 2013 mandated that teaching science in junior high school have to be taught in an integrated [1].

Science as an integrated learning helps students understand the relationship between the concepts of science. One material in science which is abstract is material of sound waves and hearing. This material is contained in the Basic Competence 3.5 for class VIII. Basic Competence 3.5 mandates the introduction of the concept of vibration, waves, sound and hearing, and its application in sonar systems in animals and in everyday life. The concept of vibration, wave, sound, sonar systems in animals and in everyday life is an abstract concept in the disciplines of physics. The concept of hearing is an abstract concept that is on the disciplines of biology.

Observations in SMPIT Alam Nurul Islam shows that there has been no learning media in the topic of sound waves and hearing which is arranged integrated based on Kurikulum 2013 which facilitate the development of the 5M ability. The use of the media during the learning process of an abstract science material can substitute the experience by presenting a simulated real experience. The use of media can also attract students to learn the abstract material [2]. Therefore, it is important to develop a integrated science learning media in the topic of sound waves and hearing which facilitate the development of the 5M ability.

II. RESEARCH METHOD

This study is a research and development, which has produced a product orientation. Products which is developed in this study is an integrated science learning media in the topic of sound waves and hearing to facilitating the development of the 5M ability.

Development procedure in this research refers to the stage of the development model which is adapted from the Borg and Gall model [3] and set by researchers. Procedure development on the study include five main stages, namely (1) the analysis of needs, (2) learning design, (3) the development of media, (4) validation, revision and testing of products, and (5) dissemination of limited research and development ,

III. RESULT

Result gained from this research and development study is a learning media in the topic of of sound waves and hearing for junior high school students which developed using Macromedia Flash Professional 8. The media consists of seven main menu, the media guide, a developer profile, learning objectives and competencies, materials, training, evaluation, and self-assessment. Product development is done through five main stages, namely a needs analysis, instructional design, media development, revision and validation of product trials, and limited dissemination. The results of the needs analysis showed some of the findings in SMPIT Alam Nurul Islam about the curriculum used is KTSP, science teaching and learning have not been integrated yet, unavailability of integrated science learning media which accordance to Kurikulum 2013, the number of students, and students' academic ability. Instructional design phase results of the analysis of competencies, learning objectives, and especially on the concept of KI-3 and KD-3.5 on Kurriculum 2013.

The development phase is done through the preparation groove media and media fields, collecting supporting materials, and materials production. The next stage is the stage of validation, revision, and product testing feedback and suggestions validator of the product into the information parts that require revision in order to repair the product. More extensive trials carried out at 8th grader at SMPIT Alam Nurul Islam using sound waves and hearing instructional media.

A test holds to explore the media support to facilitate the development of the 5M ability through the pre-test and post-test. Analyzed of 5M ability data is done by benchmarking against Kriteria Ketuntasasan Minimum (KKM) and normalized gain score. KKM for science subjects in SMPIT Alam Nurul Islam is 70. At the time of the pre-test, there are 9 students who qualify KKM. Average yield pre-test score is 60.87. At the time of the post-test there are 22 students who qualify for the KKM. Average yield post-test score was 82.61. Presentation of the results of the analysis of the cognitive aspects of learning outcomes can be seen graphically in Figure 1.

FIGURE 1. GRAPH ANALYSIS ASPECTS OF 5M ABILITY

The results of the analysis based on the calculation of the gain score showed a value of 0.56. On the classification of the gain, the value is included in the medium category with the acquisition of 0.56 where 0.7 ≥ (<g>) ≥ 0.3. This shows that the use of sound waves and hearing instructional media development results improve students' 5M ability. Benchmarking limit of gain score by Hake [4] with the acquisition of the gain score on learning outcomes 5M viability is presented in Figure 2.

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FIGURE 2. COMPARISON CHART WITH ACQUISITION OF GAIN SCORE ON STUDENTS' ABILITY OF 5M

The last stage in this study is limited dissemination. Limited dissemination of sound waves and hearing instructional media made through socialization and surrender to science teachers in SMP Negeri 1 Sentolo and SMPIT Alam Nurul Islam. Science teacher in SMP Negeri 1 Sentolo and SMPIT Alam Nurul Islam gave a positive appreciation of the development and use the media to teach the science.

The conclusions of this study **is** the use of the media improves students' learning outcomes in observing, questioning, and collecting, associating or analyzing, and communicating information skills. It is shown on the gain score difference which is 0.56 categorized as "medium".

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SE – 11

Effectiveness of Learning with Authentic Task to Improve Science Literacy Skill in Unipdu Jombang

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Abstract— The aims of this research are to implement a certain authentic task of light concepts; to evaluate the effectiveness of the task through science literacy skill includes students performances and students knowledge of the task. The study was conducted in March - May 2015. Students performance was assesed through cognitive tests, observation, and interviews. The Research sample of 30 students of 4th Semester is obtained randomly from among students of Science learning Studies using a stratified random sampling technique. This study was conducted in three phases, that is, the development of lesson plans and research instrument, validation of those instruments, and implementation of those instruments in the classroom. Observation, interview and test were implemented to collect variety information during implementation of the authentic task. The finding showed that gained scores of students performance and students knowledge pass the minimum score of UNIPDU standard. It means the authentic task has positive effect on students performance and students knowledge of the topic. Result of the research shows that, learning with authentic task is more effective to improve science literacy skill on light concepts.

Keywords: *Authentic Task, Science Literacy Skill, Authentic Learning*

I. INTRODUCTION

The emphasis of these conventional approaches has been on rote memorizing of discrete facts, principles, or concepts, and teaching them in abstract and decontextualized forms. Consequently, learners tend to adopt a surface learning, that is an approach toward learning that focuses on remembering knowledge (Yip, 2008) and view only knowledge as " the final product of education" (Herrington, Reeves, & Oliver, 2010). Teachers tends to teach the concept and theories through the conventional approaches (Timmerman, Strickland, & Carstensen, 2008). As a result, students are less able to integrate and apply the concepts that they have learned to solve other problems in their daily life since the knowledge is stored only as an information rather than as tool for problems solving (Herrington et al, 2004).

For that reason, it is thought that students need to be involved in the learning activity which allows them to get real experiences, to internalize the knowledge, and to get relevancy of real world to their work. One of alternative approaches to achieve these purposes is by engaging students in authentic learning. Gulikers, Bastiaens, and Martens (2005) revealed that the authentic learning provides a situation where students enable to use knowledge, skills, and competencies which are needed in real life conditions. In other words, this learning method stimulates learners to develop abilities which are deemed essential as citizen and for their future professional life, such as oral and writing communication, collaboration, critical thinking, and problem solving skills (Puckett & Black, 1994). Furthermore, Herrington et al. (2010) argued that students find it easier to recall learning experiences which are conducted in realistic contexts than in abstract forms. Newmann and Wehlage (1993) stated that authentic learning environment can enhance students cognitive performance and motivation to learn. Similarly, Koenders (2006) reported that authentic learning in an online environment which is implemented in biology course at university level improves students satisfaction and their experiences in learning.

Herrington et al. (2010) declared that in various learning designs the task is most important thing. In a similar fashion, Doyle (as cited in Lodewyk & Winne, 2005) described that task is a fundamental component for instruction in classroom. Thus regarding to implementation, students can be engaged in authentic learning experiences by providing them appropriate authentic task. Related to the task, Neo and Neo (2010) in the study of multimedia project found that authentic task can encourage students to be active and highly motivated learners. Moreover, Gulikers, Bastiaens, Kirschner, and Kester (2006) proved that the increase of authenticity of the task enables students to learn deeply. In other words, the authentic task enable to affect science literacy skill.

The authentic task will be more useful for students if they are assisted by a precise type of assessment that is authentic assessment. Wiggins (as cited in Darling-Hammond, Ancess & Falk, 1995) defined this assessment as an alternative one which evaluates students performance on task that re relevant to their real life. According to Wren (2009) the authentic assessment can capture the actual students knowledge and skill which cannot be conducted through the traditional paper and pencil test. Thus in this research, the two types of assessment, authentic assessment and paper and pencil test, will be more useful for students if they are implemented together.

As such reason, therefore, this research is established to implement a certain authentic task that replicates what professionals do in their field as an alternative of traditional teaching approach in light concepts and to evaluate the effectiveness of the task based on the result of science literacy skill.

II. LITERATURE REVIEW

Authentic learning

Herrington et al. (2010) defined authentic learning as a learning approach which encourages students to engage in real world relevant tasks which provide chances for “complex collaborative activities”. In line with these views, Herrington and Oliver (2000) and Honebein, Duffy, and Fishman (1993) revealed that learning authentically means that the learning enables to encourage students to develop certain knowledge, skills, and competencies by confronting them with experiences which reflect the professional practice in real workplace. Thus, the authors viewed that connecting learning to real-life context is the main requirement for ensuring the authenticity of learning.

Authentic learning is defined as an approach of learning that engages students in activites which require them to demonstrate knowledge, skills, and competencies as similar as possible to the real professionals actually do. Thus authenticity is determinated by the degree of fidelity. Herrington and Herrington (2006) contended that the most important aspect of authentic learning is not “physical fidelity” of the tasks, but process of “realistic problem solving” which is conducted by students to accomplish the tasks. The authors considered authentic ptoblem solving ability which is known as “cognitive authenticity” (Herrington & Herrington, 2006) or “construct – centered authenticity” (Cumming & Maxwell, 1999) as the primary aspect for designing the authentic learning.

Fundamentally, the authentic learning is rooted in theory of constructivist which is developed based on the work of Piaget and Vygotsky (Mathur & Murray, 2006). This theory proposed the idea that “ learners must individually discover and tranform complex information if they are to make it their own (Slavin, 2006). Drawing on this theory, Mathur and Murray (2006) found that authentic learning in physical, emotional, and intellectual perpectives enables to stimulate student to construct new ideas based on their own prior knowledge and experiences.

Basque, Dao, Contamines (2008) concluded that authentic learning is inspired by constructivist perspective, particularly sosioconstructivist theory. The emphasis of this theory is on the “role of collaboration and interaction between learners as well as between learners and the teacher or other members of comunnity in knwoledge construction” (Basque et al., 2008). In line with the view, Barab, Squire, and Dueber (2000) declared that “ authenticity is not in the learners, the task, or the environment, but in the dynamic interaction among these various component. Therefore, interaction and collaboration should be considered as important aspects in designing the authentic learning.

Element of authentic learning

Principally, authentic learning can be applied succesfully if the implementation reflects its main characteristics. With respect to characteristics, Herrington and Oliver (2000) recommended elements of authentic learning based on the situated learning theory as follows:

Provide authentic context

In authentic learning, context is an important aspect. Honebein et al. (1993) assured that learners unable to gain real picture of the real life without providing them with an authentic context that reflects the way the knowledge will be used in real life. In designing authentic context , it is insufficient to simply provide students with examples from real condition as an illustration of the concepts being taught. Herrington et al. (2010) recommended two guidelines for designing a meaningful authentic context include providing a physical environment which reflects the real condition where the knowledge will be used and a design which maintains the complexity of real world condition.

Provide authentic task

Task are crucial aspect for any learning approach. In order to provide meaningful learning, Gulikers et al. (2008) suggested that learners need to be involved in authentic tasks. With respect to the meaning, many author proposed various definitions of authentic tasks. Gulikers et al. (2005) defined the authentic tasks as activities in which students are confronted with practices which professionals do in real life. In the same way, Roth (1995) stated that the authentic tasks refer to tasks which engage learners in activity in which society members actually involve. In other words, these authors view the authentic tasks as replication of professional jobs in their real workplace.

Gulikers et al. (2004) mentioned that authentic tasks represent the real life problem which includes the thinking process that experts ude to solve the problem. Equally, Muller (2005) mentioned that "the authentic tasks is either replica or analogous to the kinds of problems faced by adult citizens and consumers or professionals in the field". Thus according to these authors, authenticity of tasks is nor determined by the degree of resemblance of the tasks, but it depends on the extent to which the task encourage students to see, to think, and to solve problems like the professionals.

Woo et al. (2007) argued that authentic tasks emphasize on using reality context for learning. Barab et al. (2000) out of school environment provides students opportunity to develop identity as a member of real community to gain knowledge and skill as well as the community member. In other words, the authors thought that merely providing students with authentic practices or problem is frequenly not authentic since they do not perceive as an integral part of the real community. Therefore, in order to provide students with really authentic tasks, they need to be engaged in authentic environment.

Althought the definition of authentic tasks can be vary according different authors, this study defined the authentic tasks as learning activities that require learners to replicate what the experts practice in their real field. Through the atsks students are expected to develop abilities that are required in this 21 st century skill, that is, cognitive competencies, such as problem solving, "meta cognitive competencies, such as reflection, and social competencies", such as comunication and collaboration (Birenbaum, 1994)

Regarding the characteristics of authentic task suggested by Herrington et al. (2006), task implemented this study enables to capture almost all of the elements of authentic task. Table 1. summarizes the manifestation of authentic task element in the task of this present study.

TABLE 1. MANIFESTATION OF AUTHENTIC TASK ELEMENTS

No	Elements of authentic task	Manisfestation
1	Authentic tasks have real world relevance	• The task replicates jobs in real workplace • The task encourage students to develop abilities that are useful for their real life, such as written and oral communiation • The task involves materials that students have been familiar with them
2	Authentic tasks are ill defined	• The task is presented simply through instruction without certain steps or procedures, such as worksheet. Thus, students will determine by themselves the sub tasks and relevant actions
3	Authentic tasks are complex activity over a sustained period of time	• The task captures the complex problem that in their field • The task will be completed within 5 meeting rather than one meeting only
4	Authentic tasks provide opportunity to use multiple perspectives	• Students are engaged in activity to identify the topic • Students are provide with many theories that very according to different author • Students are engaged in collaborative activity
5	Authentic tasks provide opportunity collaborate	• The task needs to be completed groups • Students performance are rewarded based on groups performance
6	Authentic tasks provide opportunity to reflect	• Requiring students to search from their own environment provides chance for them to reflect their own experience beyond the school • Students are provided with example of journal and poster so that have opportunity to compare their own. • Students are engage in collaborative activity so that they can reflect their own ability to the rest of group members.
7	Authentic tasks integrate subjects from different areas	• To complete the task, students need to integrate several different subject areas, such as nature science, language, communication, and art.
8	Authentic tasks are integrated with assessment	• Students performance of the task in assessed by appropriate assessment, that is authentic assessment
9	Authentic tasks create a holistic products	• The task, due to many contsraints, cannot capture this aspect because it requires students to perticipate in the real community practice in the natural settings.
10	Authentic tasks allow diversity solutions and outcomes	• The task provides students multiple solutions to process knowledge, that is, through observation, discussion, writing, presentation, and drawing • The task produces diversity of outcomes, namely journal, oral presentation, and poster presentation

(Herrington et al. 2006)

Thus, due to the constrains, the selected task of this study can capture only nine key aspects of the authentic task. However, it still enables to provide meaningful learning experiences since the task, as proposed by Herrington et al. (2006), conceives at leats six element of the authentic tasks.

Science Literacy (SL)

Science Literacy encompassing the goals of science education is considered anecessity at all levels of education (Saribas, 2015; Correia, Valle, Dazzani, & Infante Malachias, 2010). Miller (1983) suggested three dimensions of Science Literacy: an understanding of the norms and methods of science (i.e. the nature of science); an understanding of key scientific terms and concepts; and an understanding of the impact of science and technology on society. Although contemporary SL literature points out the need for additional dimensions beyond these three, Miller's framework has formed the basis of many recent studies (Saribas, 2015; Cavas, et al., 2013; Roos, 2010; Rundgren et al., 2010).

Literature about science education also investigated the components that could be related to, and enhance scientific literacy (Saribas, 2015). One of the ways of understanding that emerged from an analysis of the comments in a study by Smith (2012) examining primary teachers' views of SL was that scientific literacy was a way of engaging and motivating students to effectively learn science and work scientifically. This point of view to the conclusion that scientific literacy was connected with long-term learning components and level science literacy skill. Detail level science literacy skill are presented in Tabel 2.

TABEL 2. LEVEL SCIENCE LITERACY SKILL

No	Science literacy skill	Level
1	Student can describe methods of scientific inquiry and apply them to investigating, questioning and solving problems	Beginning The student cannot: -Identify a scientific problem -Recognize that problems have solutions -Recognize the definition of an hypothesis
		Developing The student can: -Identify and clearly state a scientific problem -Select one possible solution to the problem -Select a hypothesis appropriate to the problem
		Competent The student can: -Restate the scientific problem in a question format -Predict one or more possible solutions to the problem -Generate a testable hypothesis appropriate to the problem
		Accomplished The student can: -Develop a proper research question -Evaluate alternate solutions to the problem -Propose how to evaluate a hypothesis appropriate to the problem
2	Student can describe and carry out experimental procedures	Beginning The student cannot: -Recognize the purpose/ objective of an experiment -Determine the materials needed to complete the experimental procedure -Recognize experimental variables
		Developing The student can: -State the purpose/ objective of the experiment in their own words -Determine the materials needed to complete the procedure -Differentiate between independent and dependent variables
		Competent The student can: -State the purpose/ objective of the experiment in their own words -Determine the materials needed to complete the procedure -Differentiate between independent, dependent, and confounding variables and controls -Describe the relationship between the experimental steps
		Accomplished The student can: -Explain the purpose/ objective of the experiment in their own words -Determine the materials needed to complete the procedure -Select the experimental variables and controls -Manipulate the experimental variables and controls -Suggest modifications of the experimental design, as appropriate
3	Student can perform laboratory tasks appropriate to the field.	Beginning The student cannot: -Obey safety rules and handle lab equipment safely -Follow written procedures -Identify scientific tools appropriate to the task -Work independently
		Developing The student can, with frequent reminders: -Obey safety rules and handle lab equipment safely -Follow written procedures accurately -Employ scientific tools with proper technique -Measure and record data
		Competent The student can independently: -Obey safety rules and carefully handle lab equipment

No	Science literacy skill	Level
		-Follow written procedures accurately -Employ scientific tools with proper technique -Measure and record data with minimal errors
		Accomplished The student takes initiative to: -Obey safety rules and carefully handle lab equipment -Follow written procedures accurately -Employ scientific tools with proper technique -Measure and record data accurately
4	Student can interpret and communicate scientific information using written, oral and/or graphical means	Beginning The student cannot: -Interpret quantitative information from tables and graphs using basic vocabulary
		Developing The student can: -Interpret quantitative information from tables and graphs using vocabulary appropriate to the discipline -Construct data tables and represent information graphically
		Competent The student can, with few errors: -Interpret quantitative information from tables and graphs results using technical vocabulary -Independently construct data tables and represent information graphically. -Communicate experimental or investigative results
		Accomplished The student can, with few to no errors: -Accurately interpret quantitative information using highly technical vocabulary and make appropriate inferences -Independently construct data tables and represent information graphically -Clearly communicate experimental or investigative results -Draw logical conclusions from collected data
5	Student can describe and analyze one or more relationships among science, technology and society and demonstrate an understanding of scientific applications in everyday life	Beginning The student cannot: -Identify a technological breakthrough and its connection to science
		Developing The student can: -Identify a technological breakthrough and its connection to science -Place a technological breakthrough in an historical context -Explain some of its impacts on society
		Competent The student can: -Identify a technological breakthrough and its connection to science -Place a technological breakthrough in an historical context -Explain some of its impacts on society -Explain one or more scientific principles behind a technology
		Accomplished The student can: -Identify a technological breakthrough and its connection to science -Place a technological breakthrough in an historical context -Explain and analyze some of its impacts on society -Explain one or more scientific principles behind a technology -Describe examples or possible future developments related to science, technology and society
6	Student can demonstrate logical reasoning in explaining natural phenomena, experimental procedures or outcomes, and/or application of scientific or technological concepts.	Beginning The student struggles to: -Identify logical explanations for observed phenomena
		Developing The student can: -Identify logical explanations for observed phenomena -Identify fallacies or illogical conclusions based on observations
		Competent The student can: -Identify possible alternative logical explanations for observed phenomena -Identify fallacies or illogical conclusions based on observations or data
		Accomplished The student can: -Develop possible alternative logical explanations for observed phenomena -Describe fallacies or illogical conclusions based on observations or data -Evaluate claims based on observation, experimentation or data presented

(Development from OECD, 2013; Gormally, 2012)

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In the knowledge and information laden 21st century society, it is crucial for all citizens to direct regulate their own learning and training level science literacy skill. However, this dimension is not sufficiently discussed in the literature on scientific literacy even though regulating one's own learning plays a greater role for citizens for evaluating an idea and a claim when they encounter various problems and search for new ways to solve problems (Saribas, 2015; Choi et al., 2011). Considering this point of view, it could be concluded that scientific literacy was also related to regulation of learning.

Personal attributes, such as perseverance for learning can be significant for understanding science. However, these important attributes are often neglected in science education (Saribas, 2015; Holbrook & Rannikmae, 2007; Holbrook, 2010). For the fulfilment this gap, self-determination and perseverance within learning need also to be included in the six components that affect science literacy skill.

III. METHODOLOGY

Research context and sample

This research can be categorized as a mixed method, quantitative and qualitative case study since it aim to investigate deeply a certain case, that is implementation of authentic task in a particular class at a university level in which the relevant behavior cannot be manipulated (Lodico, Spaulding, & Voegtle, 2010; Merriam, 2009; Yin, 2003). With respect to the type of case study, this research can be considered as an example of "intrinsic case study" where the researcher interest to investigate deeply a prticular case without necessarily constructing general understanding (Fraenkel, Wallend, & Hyun, 2011) since basically authenticity that involved in the study is subjective matter.

This study involve only one class that consist of approximately 30 bachelor degree student at 4th semester PGMI of Unipdu Jombang with ages ranging from 18 to 25 years old studying science learning and light concepts as subject of research. This study, especially for tryout was conducted during March until May 2015 at 4th semester PGMI of Unipdu Jombang.

Instruction

This research involved three phases, the first phase is development of the lesson plans and the research instrument. The second phase is validation of the lesson plan and the research instrument by experts. The last phase includes implementation of the lesson plans and the research instrument in classroom.

Before conducting study, the lesson plans and several research instruments are necessary to be developed for guiding and collecting data during the study. The lesson plans which are developed in this study contain authentic task of light concepts. The lesson plans aim to provide a guide for implementation of authentic task in classroom. Besides, in this study, several research instrument are developed for collecting data. The research instrument include instrument for assessing science literacy skill , such as authentic assessment sheet for scientific journal writing, for oral presentation, for poster presentation and paper and pencil test sheet; and instrument for observation of the obstacles that occur during implementation

The developed lesson plans and research instruments include authentic assessment sheet, paper and pencil test sheet, and observation sheet, then are validated by experts. The objective of validation is to get some suggestion from the experts in designing as perfect lesson plans and research instruments as possible for implementation of authentic task. In this case, the validation includes the design, the content, the learning material, and the language. It is done by the one that competent on designing both of them, competent on subject under study and competent on English language.

The validated lesson plans and research instrument that have been validated are revised based on the experts suggestion. Then the revised lesson plans and research instrument are implemented for guiding and collecting data of study.

Implementation of the lesson plans and the research instrument is conducted in two phases, research tryout and real research. The collecting data activities during the tryout were conducted using research instrument that have been validated. Then, the data were analyzed to provide information for making comprehensions paper which needed to be tested by some competent experts. The suggestions got during the test can be used as reference for revising the lesson plans and the research insturment that will be implemented in real research. The real research will involve approximately 30 bachelor degree students that studying science learning about light concepts. During the real research, the collecting data activities will be conducted using research instrument that have been revised.

Regarding to design, the study will focuses only on one class for getting deep description about the effectiveness of the authentic task which is implemented in the class.

IV. RESULTS

Result of assessment on science literacy skill

In this research, science literacy skill is classified into two type, that is, Student can interpret and communicate scientific information using written, oral perfomances on authentic task that are assessed by authentic assessment and students acquired knowledge of light concepts that is assessed through paper and pencil test. The result for each assessement types are presented in following sections

Result of authentic assessment

For this study, authentic assessment is conducted to assess three type of student performance, namely, writing scientific journal, oral presentation and poster exhibition skills. Detail result of authetic assessment are presented in Tabel 3.

TABEL 3. RESULT OF AUTHENTIC ASSESSMENT

Group	**students**	**Students score**		
		Writing journal	Oral presentation	Poster exhibition
A	1,2,3,4,5	78	80	88
		Average score	**82**	**Grade A**
B	1,2,3,4,5	80	83	86
		Average score	**83**	**Grade A**
C	1,2,3,4,5	82	80	90
		Average score	**84**	**Grade A**
D	1,2,3,4,5	75	80	80
		Average score	**78**	**Grade B**
E	1,2,3,4,5	79	82	82
		Average score	**81**	**Grade A**
F	1,2,3,4,5	80	84	83
		Average score	**82,3**	**Grade A**

According to the result of authentic assessment in Tabel 2., performance score of six groups involved in this tryout of study range from 75 to 90. Comparing with Uipdu score standard in Tabel 4.

TABEL 4. SCORE STANDARD

Score interval	**Criteria Grade**	**Explanation**
80-100	A	Pass
66-79	B	Pass
56-65	C	Pass
40-55	D	Do not pass
0-39	E	Do not pass

(Source: Buku Pedoman Unipdu, 2014.)

Their score are in the upper level of the minimum score of Unipdu standard, that is 56. In addition with respect to Unipdu grade standard shown in Table 3., the performance score of six groups in this study range grade B to A. Thus, regarding to the scores of authentic assessment, students in this study have good performance on the authentic task. Overall, the performance of group C are better than the performance of group A,B,D,E,F.

Result of paper and pencil test

In addition to authetic assessment, paper and pencil test is carried out in this study in order to assess students acquired knowledge of light concepts. Students achievement science literacy skill for the test are presented briefly in the following chart.

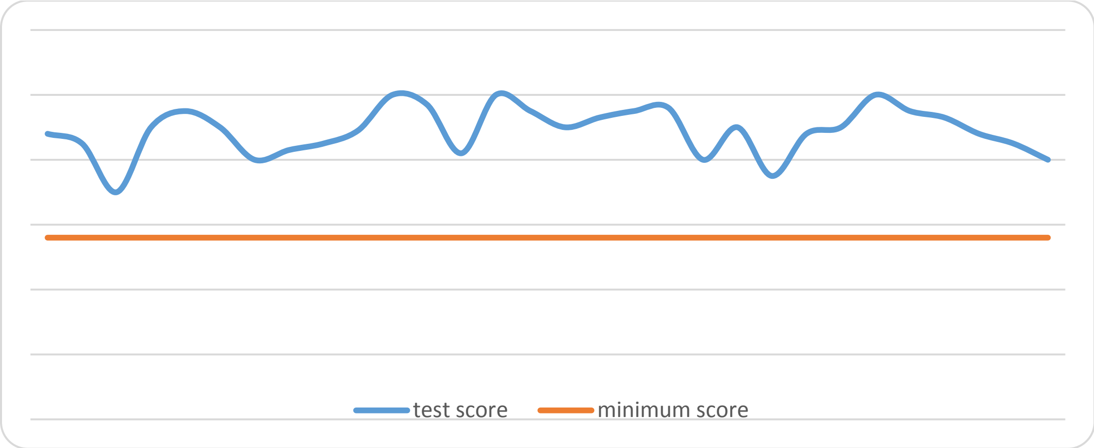

FIGURE 1. CHART OF PAPER AND PENCIL TEST RESULT

The chart shows that scores of paper and pencil test for all of students in this study are located in the upper level of minimum score of Unipdu standard, that is, 56. Even there are three students (in the chart), student 11, 14, and 25, gained the maximal score that is, 100. Overall, students mastery of the topic under study is very good.

Results of the observation

In addition to assessment and interview, this research study involved the observation in the class in order to get information about difficulties that lecturer and students may face during implementation of the authentic task. The observation results which are gathered form observation sheet are presented in the following Tabel 5.

TABEL 5. OBSERVATION RESULTS FROM OBSERVATION SHEET

No	Obstacles	Solutions
1	Students cannot identify the topic	Lecturer needs to provide guidance for the students
2	Some students do not understand what the lecturer said	Lecturer needs to use bilingual during the lesson to ensure students comprehension
3	Students English ability needs improvement	Lecturer revises students errrors in using English language and Indonesian Languange
4	Due to difficulty of language, students presentation are frequently confusing audience	Lecturer is necessary to restate students explanation

Overall, to solve those obstacles, researcher and observers proposed a solution that is, improving assistances for students.

V. DISCUSSION

In summary, according to discussion presented above, the authentic task which is implemented in this study has positive impact on not only students performance which is assessed by authentic assessment, but also students knowledge that is assessed by paper and pencil test because thetask enable to motivate students toward learning and to increase knowledge retention. Moreover, the task is perceived as authentic one by both developer and students. As a result, it enables to enhance students motivation toward learning since students perceive that the task is useful for their future professional life and it has connectivity with their daily life. Therefore, based on the result of science literacy skill , it can be judge that the authentic task is effective for the light concepts of study. However, there were three obstacles occurred during implementation of the authentic task, they were students confusion of the task, students difficulty in identify of characteristic light, and language difficulties which need some revisions. These obstacles were overcome by improving assistances form lecturer.

Summary of the research findings

This present study aims to evaluate effectiveness of an authentic task on science literacy skill in light concepts. Overall, the findings during the study are presented in the following sentences.

1. Regarding to Unipdu grade standard, the applied authentic task of this present study has good impact on students performances on the task.
2. According to Unipdu grade standard, the implemented authentic task of the current research has positive impact on student knowledge of light concepts, especially for refraction topic.

3. related to the perception, students perceived the authentic task in this study is authentic and useful for their future professional life.
4. The study proposed three difficulties during implementation of the authentic task, that is, confusion of the task, difficulty in identify characteristic light, and language difficulties which need some revisions.

VI. CONCLUSION

In conslusion, based on the findings of students performances, students knowledge that have been presented above, the implemented authentic task in this study is effective for learners in order to gain good learning achievement science literacy skill of light concepts, especially for topic of refraction, in term of performances that are assessed by authentic assessment and acquired knowledge of the topic which is assessed by paper and pencil test. However there were three main obstacles occurred during implementation of the authentic task, namely students confusion of the task, students difficulty in identify characteristic light, and students language difficulties

Limitations

There are several limitations of this present research, firstly, this study is case study reseach that focuses on deep investigating of only one class as subject of study. Thus, the findings cannot be generalized for broader population. Secondly, the task is conducted only for 5 meetings. The longer period will provide better result as students have enough time to complete the task optimally. Thirdly, the current study concerns with biases since it implement authentic assessment the asses students performances. Moreover, the assessor I only the lecturer. Fourthly, the develop authentic task of this study captured only nine of ten element of authentic task. Due of many constraints, one element of authentic task, that is, creating a holistic products cannot be covered by the task in this study. Lastly, the authentic task is appropriate to be implemented only in a class with small number of students.

Recommendations

Based on the findings of this study, there are some suggestions are proposed for futher research as follows:

1. For supporting the findings of this research, the next advance study is necessary to be conducted in form of experimental research by comparing a certain class which is taugh using authentic tasks and another class which implement conventional teaching approach.
2. In order to design authentic task, developers need to consider the time because the task cannot be carried out during unrealistic time constraint.
3. In order to avoid biases, authentic assesssment need to be completed by more than one assessor that competent on assessing student performances.
4. To provide valid conclusion about student abilities, the authentic task needs to be implemented using national language rather than foreign one because language difficulties frequently restrict student to perform their actual abilities.
5. Investigation of effects of authentic task on science literacy skill with different gender and different level of achievement are necessary.

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SE – 12

Inquiry Science Issues to Cultivate the Critical Thinking in Science Learning

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Abstract—Learning science should be conducted in accordance with the nature of science, they are science a body of knowledge, science a way of investigation, science a way of thinking, and application in technology. As part of the process, learning science should be taken of scientific inquiry in order to be able to cultivate the thinking skills, work and communicate scientific attitude as well as an important aspect of life skills. An inquiry approach is to learning that emphasizes the discovery of something through the process of looking for by using scientific methods. In order to learn science in scientific inquiry, in learning science should be supported with thinking skills. Students are expected to critically to find problems in life and creatively seek solutions. Problems found students are the problems and issues around students. Integrating science learning between inquiry and science issues will create meaningful science learning. Steps in the approach Inquiry Science Issues orientation on science issues, formulate problems, formulate hypotheses, collect data, test hypotheses, and drawing conclusions.

Keywords: *Inquiry, Science Issues, Critical Thinking, Science Learning*

I. INTRODUCTION

Science with regard to how to find out about natural phenomena. Science is not only a mastery of knowledge in the form of a collection of facts, concepts, or mere principles but also a process of discovery. Science subjects is a vehicle for students to learn about themselves and the natural surroundings, as well as prospects for further development in applying it in everyday life (Mulyasa, 2010: 110).

Science is essentially the product, process and attitudes/Values. Therefore, as part of the process of national education, science teaching should be taken of scientific inquiry in order to be able to cultivate the ability to think, work and behave communicating scientific as well as an important aspect of life skills (BSNP, 2006). The content of science refers to its many disciplines, such as biology, chemistry, physics, geology, anthropology, and so on, each of which is concerned with a specific body of knowledge and includes the theories and conceptual ideas that cross all of the disciplines. Inquiry is the first step in the process used by scientists to uncover that which they seek to understand and, as a term, simply refers to asking relevant higher-order questions. Discovery is both the process of gaining scientific knowledge and skills and the culmination of what is learned. Combining the learning of content with inquiry practices is what we call the scientific enterprise. Enabling students to understand the nature of this enterprise is a major goal of the inquiry instructional approach.

Inquiry learning is learning that emphasizes the discovery of something through the process of looking for by using scientific measures. In inquiry, students are expected to critically encounter problems in life and creatively seek solutions. In order to learn science in scientific inquiry, in learning science should be supported with thinking skills. Learning science should be hands-on and minds on (Word & Widodo, 2008). The process of learning science is not sufficiently implemented by conveying information about the concept, but also to understand the occurrence of the phenomenon of IPA to perform sensing as much as possible, observing the events that occur directly through demonstration and experimentation activities, and record information that emerged from these events. Some allegedly students actively explore the subject matter, construct their own ideas derived from observation and discussion, students are expected to master the material well and improve thinking skills.

Inquiry approach can develop skills science of student, such as process skills, thinking skills (critical and creative thinking), and also a scientific attitude. In addition to the inquiry learning will bring up students' skills in conducting investigations, practical skills of students will be developed. Currently science teaching is focused on the product, so that the skills and scientific attitude has not yet developed through a learning process. Implemented integrated science teaching has meaning integrating various aspects of domain attitudes,

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knowledge, and skills. Learning science should be oriented applicative, development thinking Skills in science, learning ability, curiosity, and the development of caring and responsible attitude to the natural environment and social development in science learning. Thus the science learning should be designed and implemented through a strategy that can meet the needs of the contextual so that students can deal with the real problems in the environment to support the formation of knowledge, values, and attitudes. One of these strategies can led to a thriving science community issues. By bringing up the issues in the community in learning science, students can develop the ability to think and act as well as the ability to resolve concerns raised as issues of science with conducting an investigation that is able to bring the ability of practice (practical skills) and also the ability of literacy science that will produce students who has a positive character in science learning.

II. Inquiry in Science

Inquiry as an approach to teaching science was becoming increasingly evident. Inquiry implies as all student activities in which they build knowledge and understanding of the idea of science as practiced by scientists in discovering and building understanding (NRC, 1996). The National Science Teachers Association (NSTA) defines inquiry as a powerful way of understanding science content. Students learn how to ask questions and use the facts to answer these questions. In the process of inquiry learning, students learn to conduct an investigation and collect data from various sources, develop a description of the data, and communicate and determine conclusions.

Using science inquiry learning helps students put the problem into the right context, develop critical thinking skills, better engage students in learning, increase students' positive attitudes towards learning science, as well as improving communication skills. Broadly speaking, inquiry-based learning model has the important things in which each stage has a specific purpose, they are:

1. Brainstorming; aims to foster curiosity in students
2. Define the problem; aims to focus students on what you want to search
3. Formulate a temporary answer; aims to make students trained to formulate answers while
4. Predicting; aims to make the students design the proper way to test the transient response
5. data collection; aims to train observation abilities in students
6. Process the data; aims to train data interpretation capabilities
7. Drawing conclusions; aims for students are trained how to make inferences from data obtained trends
8. Applications concept; students are able to look for relationships, applications, and make synthesis concepts learned in different situations.

Based on the stages of the inquiry learning that exist on the above, it can be conclude that that inquiry learning is learning that is suitable if you want to training ability scientific literacy in students. Stages of the existing on the science training capabilities are owned by scientists so indirectly this model can train ability high order thinking, one of them is critical thinking.

Inquiry teaching and learning have five essential features that apply across all grades levels, they are :

1. Learners are engaged by scientifically oriented question
   Scientifically oriented question center on objects, organism, and events in natural world. They connect to the science concept described in the content standard. They are question that lend themselves to empirical investigation and lead to gathering and using data to develop explanation for scientific phenomena.
2. Learners give priority to evidence, which allows them to develop and evaluate explanation that address scientifically oriented question.
   Science distinguishes itself from other ways of knowing through use of empirical evidence as the basis for explanations about how the natural world. Scientists concentrate on getting accurate data from observation phenomena
3. Learners formulate explanation from evidence to address scientifically oriented question
   This aspect of inquiry emphasizes the path from evidence to explanation rather than the criteria for and characteristics of the evidence. Scientific explanation based on reason.
4. Learners evaluate their explanation in light of alternative explanations, particularly those reflecting scientific understanding
   Evaluation, and possible elimination or revision of explanations. Alternative explanation may be reviewed as students engage in dialogues, compare result, or check their result with those proposed by the teacher or instructional material.
5. Learners communication and justify their proposed explanation
   Scientists communicate their explanation in such a way their result can be reproduce (national research council: 2000)

III. CRITICAL THINKING IN SCIENCE

Critical thinking is the process of independently analyzing, synthesizing, and evaluating information as a guide to behavior and beliefs. The American Philosophical Association has defined critical thinking as "the process of purposeful, self-regulatory judgment. The process gives reasoned consideration to evidence, contexts, conceptualizations, methods, and criteria" Critical thinking is sometimes broadly defined as "thinking about thinking." Critical thinking skills include the ability to interpret, verify, and reason, all of which involve applying the principles of logic. The process of using critical thinking to guide writing is called *critical writing*.

In supporting critical thinking, the goal is to help students approach any task, problem or issue in an open-minded manner, to look carefully at the various options and to reach reasonable conclusions based on careful assessment of relevant factors. Critical thinking is about being thoughtful about everything students do and study in school. A useful definition of critical thinking is as follows: To think critically is essentially to engage in deliberations with the intention of making a judgement based on appropriate criteria. Helping students think critically involves inviting them to assess the merits of various options before them on the basis of relevant factors. Critical thinking is an important approach to teaching because of the enhanced satisfaction and learning that results when students are challenged to use and apply the ideas in the curriculum. Students who receive information in a passive manner are less likely to understand what they have heard or read about than are students who have critically scrutinized, interpreted, applied or tested this information. Presenting subject matter in the context of a problem or an issue is more motivating to students and more likely to develop deeper understanding. Critical thinking is encouraged by discussing which of the suggested solutions to a dilemma raised by a playground incident or by a story is the most effective, feasible and safe. Instead of simply picking a title that students would like for their persuasive paragraph, they could be asked to decide which of several possibilities was the most informative and engaging.

Developing effective critical challenges questions or tasks that invite students to think critically is not an easy matter. Teachers need to think critically about their questions. Because thinking critically involves thinking with criteria, it is appropriate to consider what criteria would be useful in judging whether a proposed question or task actually invited students to think critically. Effective critical challenges meet the four criteria, they are:

1. invite reasoned judgement among plausible alternatives
   It is essential that challenges pose questions or tasks that invite students to judge the reasonableness of plausible options or alternative conclusions. Since criteria are essential to making reasoned judgements, the appropriate criteria should be implicit in the question. For example, assessing the quality of an information source involves considering its level of detail, accuracy and balance; choosing a classroom pet requires considerations of cost, size and ease of handling
2. limit the amount of background knowledge required
   If students lack crucial background knowledge or are unaware of relevant criteria, and if they do not acquire these tools as they address the challenge, then the value of posing challenges may be lost. Students are likely to flounder if they lack basic information presupposed by the challenge. Critical challenges must be sufficiently delimited so students need not possess encyclopedic knowledge in order to realize success. Another way to reduce the amount of background knowledge is to restrict critical challenges to a single information source. In this way, students could acquire the information they need simply by studying the supplied material
3. are perceived as meaningful by students
   If students view a challenge as irrelevant and unimportant, they are unlikely to engage seriously in the activity and, over time, are likely to regard critical thinking as a boring or trivial exercise. Critical challenges are likely to engage students to the extent that the challenges:
   a. create dissonance with students' pre-existing beliefs
   b. involve real (or, at least, realistic) problems (issues in daily life)
   c. have an obvious connection with a contemporary event, the local community or a personal concern of students
   d. provide a sufficiently rich context so students are drawn into the situation
   e. to the extent possible, are chosen or suggested by students themselves.
4. advance students' understanding of the content of the curriculum
   Critical challenges should involve students in thinking critically about what we want them to learn from the curriculum. In this way, they are more likely to master the desired curriculum outcomes. Content is likely to have little meaning for students if they merely retrieve and present information. For example, instead of asking students to compare and contrast the services offered in two communities, we might ask them to judge which community better meets its members' needs. In the course of justifying their judgements, students will better understand the curricular outcome dealing with an appreciation of the ways in which different communities meet individuals' needs.

IV. INQUIRY SCIENCE ISSUES

Scientific inquiry refers to the ways scientists to study nature and the evidence from the investigation. An inquiry reflects an understanding of how the science results of the investigation process. (Anderson, Ronald D., 2002: 2). Science Teachers should encourage their students to learn the scientific inquiry that learning can be active. Parameter preparation of science teachers who have a standard of scientific inquiry, science teachers must show that: 1) Understand the processes, principles and assumptions of the inquiry approach in finding scientific knowledge. 2) Invite students successfully develop inquiry appropriately, especially in developing concepts and relationships observations, the data and conclusions scientifically. Nana Sudjana (2004: 154) inquiry is a model teaching approach by laying the groundwork and develop a scientific way of thinking. More students develop their own concepts in problem solving so that students serve as the subject of learning, while teachers act as mentors and facilitators in the learning. Inquiry learning is learning to develop processes and scientific knowledge so that students can have the scientific reasoning and critical thinking to develop an understanding of scientific concepts. In Inquiry learning, students become a natural scientist (Sund and Throwbridge, 1973: 62-78).

Inquiry is a learning process of the student to find the knowledge and skills The essence of inquiry approach is to engage students in a real problem to be investigated. Inquiry approach helps students to identify problems and encourage students to design a way to resolve the issue (Joice, Bruce & Well, Marsha, 1996: 187).

Inquiry is an approach that engages students in scientific inquiry activities. To be effective, inquiry learning should include basic skills in scientific investigation as well as an understanding of how scientists do their work. Inquiry-based learning should emphasize the importance of the learning process, such as formulating questions empirically and support the knowledge of the evidence (Kubicek, John P., 2005: 3). According Kilbane, Clare R. and Milman, Natalie B (2014: 244), Inquiry learning is process-oriented and aims to teach students practice the skills, knowledge, and attitudes. Skills, knowledge, and attitudes are used to answer an important problem or issue. Based on the theories above, it can be concluded that the inquiry approach is an approach to learning that is oriented towards the identification of problems/issues and ways of solving the problem. The troubleshooting process can practice the skills, knowledge and attitudes. Inquiry provides direct learning experience for the students involved in the problems of their investigation.

The proceedings provides a real learning experience and active, where students are trained how to problem-solving and makes his own decisions. Through an investigation that started from questions, challenges students to use in solving thinking. Students are required to be fully responsible for the learning process, so the teacher must adapt to the activities undertaken by the students. General inquiry learning process can follow the steps below:

1. Formulate the problem, the ability shown in this stage is awareness of the problem, see the importance of the problem, formulate the problem
2. To formulate the hypothesis, the ability shown in this phase is to test and classify types of data that can be obtained, see and formulate the relationships that exist logically, to formulate hypotheses.
3. Collect evidence, at this stage, students can collect the data, evaluating data, and compile data.
4. Test the hypothesis, at this stage, students analyze the data, look at the relationship, noting the similarities and differences, identify trends, frequency and regularity.
5. Draw conclusions while, the ability shown in this stage
6. Look for patterns and meaning the relationships, to formulate the conclusion.

Learning science would be more meaningful if the contextual based learning undertaken. Contextual learning is learning the material linking science with real-world context facing students everyday either within the family, community, and environment, so that students are able to make the connection between knowledge possessed by its application in everyday life. Based learning is the issue exposes students to the real-life problem situations (authentic) and meaningful, to facilitate students to break through the investigation / inquiry and cooperation, facilitate dialogue on the various aspects, and stimulate students to produce work of solving.

Socio-scientific issues are used to present and represent the social problems associated with contextual science (Nuangchalerm, 2010: 34-37). SSI allows individuals / groups of students to deal with conflict situations involving science and social life. A conflict situation can be contributed to the increased awareness of the character of the social, ethical, cultural and even political and economic in students and to capital to make a decision in later life. SSI can be found in the global context, such as the issue of genetic engineering (gene therapy, cloning) and environmental problems such as global warming and climate change (Sadler & Zeidler, 2005: 112-138). The example of SSI is a global context, namely sustainable development, energy resources, food, health, and population control. In addition, SSI can also be sourced from the local community, such as the issue of the impact of Merapi eruption events (A. W. Subiantoro, 2013: 41-47). Socio-scientific issues help the students to develop a deeper understanding the issues and the essence of science itself. Investigation and analysis of SSI requires inquiry and put forward the idea of working in a laboratory, in the field, using the Internet, and others (Chiappetta, Eugene L. and Koballa, Thomas R., 2010: 202).

In its implementation, socio scientific issues require inquiry to analyze the issue of social issues related with science. Inquiry science issues can be incorporated into a learning approach to investigate problems or issues IPA happens in everyday life. Learning with this approach starts when the teacher to show problems or issues that exist in the community to be investigated by the students. Step into science inquiry learning approach issues that orientation on science issues, formulate problems, formulating the hypotheses, to collect data, test hypotheses, and drawing conclusions. In step orientation, students are faced with the problem of scientific issues presented so that the first phase is called the orientation on science issues. Step of formulate of problems, students are guided by the teacher to identify problems and make the formulation of the problem. The problem is formulated by the students, so that students have a high motivation to conduct an investigation on the issue of science. After formulating the problem, students were invited to write a hypothesis or a temporary answer to the issue of science being studied. Therefore, the hypothesis needs to be tested for truth by step collect data. Collecting data is an information gathering activity data needed to test this hypothesis to determine whether an answer is received or not based on data or information collected. The last step is to formulate a conclusion the researchers used, a process describes the findings obtained based on the results of hypothesis testing.

V. CONCLUTION

Scientific inquiry refers to the ways scientists to study nature and the evidence from the investigation. An inquiry reflects an understanding of how the science results of the investigation process. Learning science should be conducted in accordance with the nature of science, they are science a body of knowledge, science a way of investigation, science a way of thinking, and application in technology. As part of the process, learning science should be taken of scientific inquiry in order to be able to cultivate the thinking skills, work and communicate scientific attitude as well as an important aspect of life skills. An inquiry approach is to learning that emphasizes the discovery of something through the process of looking for by using scientific methods. In order to learn science in scientific inquiry, in learning science should be supported with thinking skills. Students are expected to critically to find problems in life and creatively seek solutions. Problems found students are the problems and issues around students. Integrating science learning between inquiry and science issues will create meaningful science learning. Steps in the approach Inquiry Science Issues orientation on science issues, formulate problems, formulate hypotheses, collect data, test hypotheses, and drawing conclusions

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SE – 13

The Model of Educational Reconstruction: Integrating Content and Nature of Science in Teaching Materials

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Abstract—To improve instructional practices has been a major concern of science education research and development. The teaching and learning of science is the main focus of science education. The model of educational reconstruction (MER) is a widely used research programme that was developed to improve content specific learning and teaching. The MER integrates the perspectives of students and scientist in order to design learning environments. By example of an educational reconstruction of content and nature of science we show how the MER can help to analyse, design and evaluate learning environments fostering a conceptual understanding. Helping students develop informed views of nature of science (NOS) has been and continues to be a central goal for kindergarten through Grade 12 science education. Our focus is on ideas about the reconstruction of integrating content and nature of science in teaching materials. First we examine about MER in science education, next we provide an overview of recent developments about NOS, and the last we give an example how to integrate content and nature of science in teaching materials using model of educational reconstruction.

Keywords: *MER, NOS, science education, teaching materials*

I. INTRODUCTION

Science education is concerned with the teaching and learning of science content and practices. The teaching and learning of science is the main focus of science education. It requires fruitful strategies to engender a conceptual understanding. The goal of Model of Educational Reconstruction (MER) is to improve content specific learning and teaching. The MER integrates the perspectives of students and scientists in order to design learning environments.

The MER provides a broadly conceived approach for subject-matter education research. It provides a frame for research to design teaching and learning sequences that are relevant for improving instructional practice [6]. The MER integrates the perspectives of students and scientists in order to design learning environments. The MER strands on two feets-one foot in the discipline and other in education. Both perspectives are brought together to design domain-and topic-specific theories of teaching and learning science. The design is lead by learning capabilities of the students on the one hand and clarification of science content on the other hand. The MER presented in this chapter provides a conception of science education research that is relevant for improving instructional practice and teacher development program.

Teaching and learning in science education is not only focus on the knowledge of science (content of science) but also knowledge about science (nature of science). Therefore, teaching the understanding about Nature of Science (NOS) should be conducted while teaching the content. But, in some countries (especially in Indonesia), understanding about NOS does not explicity embedded in teaching and learning of science. So, teaching materials which integrate content and NOS are important to help teachers for teaching content and NOS simultaneously. Reconstruction of teaching materials is needed to produce the teaching materials. MER can be used to reconstruct and design the teaching materials.

II. DISCUSSION

A. MER in Science Education

The Model of Educational Reconstruction (MER) is a framework for research on content specific teaching and learning. A key concern of the Model of Educational Reconstruction (MER) is that science subject matter issues as well as student learning needs and capabilities have to be given equal attention in attempts to improve the quality of teaching and learning. Reconstruction means the process that transform (or translate) domain specific knowledge into knowledge for instruction [14]. The content structure of the discipline differs from the content structure for instruction in that the latter is reduced to the elementary ideas but also enriched by contextual embedding and customizing and thereby reconstructed. Teachers or researchers (in this model) working with the model analyse, design and evaluate instructional approaches striving to facilitate learning and teaching. The results of this model is content-oriented theories on conceptual development (design-based research) as well as in evidence-based and theory guided analysis, design and evaluation for learning environment. There are three major emphases that are intimately connected in MER as in [6], i.e :

1) The clarification and analysis of science subject matter (including key science concept and principles like evolution, energy, particles, or combustion, and science processes and views of nature of science, as well as the significance of science in various out of school contexts).
2) The investigation into student and teacher perspectives regarding the chosen subject (including pre-instructional conception, affective variables like interest, self-concepts, attitudes, and skills).
3) The design and evaluation of learning environments (e.g. instructional materials, learning activities, teaching and learning sequences).

Three components of the MER as in [14] are almost similar to the [6], i.e: 1) clarification of science content, 2) critical analysis, and 3) analysis, design, and evaluation of learning environment. The differences are the process of analysis as in [14] done at the last major emphases and the critical analysis just focusing at the students' perspectives. The other major emphases are the same as in reference [6]. Clarification of science content draws on qualitative content analysis of reliable source like leading textbooks on the topic under inspection. The aim is to clarify the specific science content structure as constituded by the related conceptions from an educational point of view [14]. A critical analysis is necessary because academic textbooks address experts and present knowledge in an abstract and condensed manner that is not accessible for novice learner. It is also widely accepted by science educators that it is necessary to take the students' prior conceptions into consideration within the learning discourse. Investigation into students' perspectives aims at pre-instructional conceptions and conceptual development. Analysis, design and evaluation of learning environments refer to instructional materials, learning situations, and teaching and learning sequences.

The teachers or researcher should perform the "design of learning environments" after iterating the two first steps "investigation into students perspectives" and "clarification of science content", aiming to adopt subject matter knowledge as presented in textbooks or other scientific publications to the perspectives of the students in such a way that suitable teaching content could be constructed. Figure 1 points to the fundamental interaction between the three components of the MER. Each of the three components was regarded as equally important [8]. However, the three components do not strictly follow upon another but influence each other mutually. Consequently the procedure must be conducted step by step recursively [14]. Reference [6] depicts the research design which is derived from the model of educational reconstruction. Reference [14] gives the example of idealized process of actual research progress of the educational reconstruction of climate change.

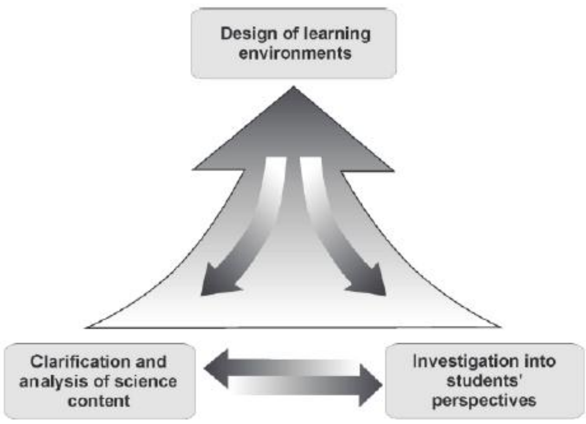

FIGURE 1. THE MODEL OF EDUCATIONAL RECONSTRUCTION AS PROPOSED BY KATTMANN ET AL. [8]

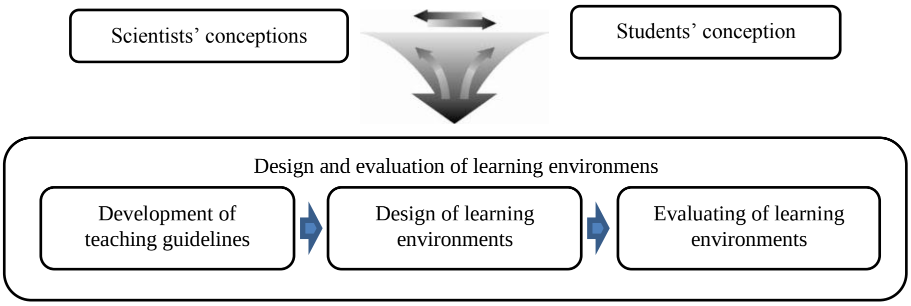

FIGURE 2. RESEARCH DESIGN DERIVED FROM THE MODEL OF EDUCATIONAL RECONSTRUCTION

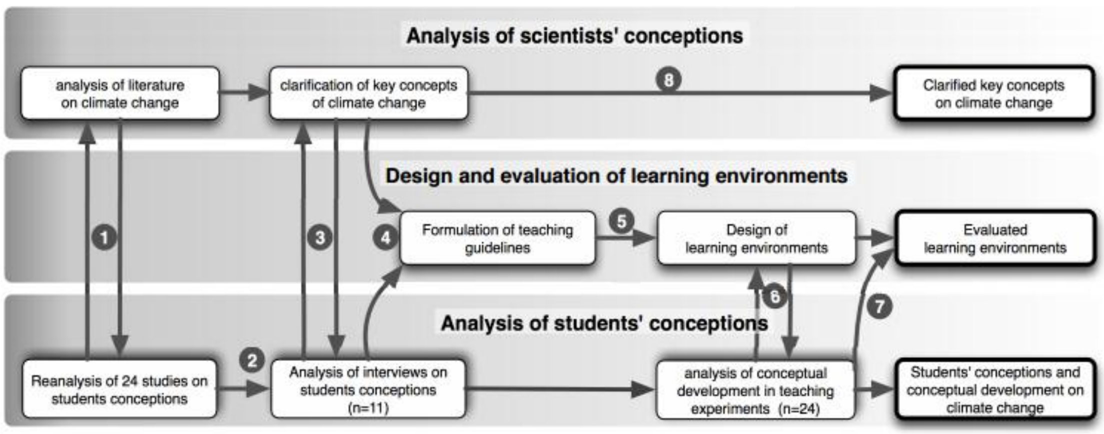

FIGURE 3. THE EXAMPLE OF IDEALIZED PROCESS OF ACTUAL RESEARCH PROGRESS OF THE EDUCATIONAL RECONSTRUCTION OF CLIMATE CHANGE

The example of idealized process of actual research progress of the educational reconstruction of climate change as in [14] started with parallel analysis of scientistc' conceptions and students' conceptions (1). After mutually relating them to each other, a deepened analysis of students' conceptions to the scientists' conceptions in an interview study followed (2). These conceptions to the scientists' conceptions were related (3) and the results of this was taken for the development of teaching guidelines (4). These teaching guidelines were operationalized in learning environments. The cornerstone in designing learning environments within the MER is the teaching experiment. In the teaching experiment the interviewer asct as researcher adn the teacher at the same time. (5). This learning environments were probed in a formative evaluation by teaching experiments (6). Based on the analyses, the research resulted in empirically evaluated learning environments and the description of students' conceptions and their conceptual development in working with these learning environments (7). Additionally clarified key concepts relevant for teaching climate change were gained.

B. Nature of Science (NOS)

Nature of Science (NOS) has long been promoted an important content of science education [9] and has consequently been included in multiple standard document worldwide e.g AAAS, 1993 [2]; National Research Council, 1996 [11]; McComas & Olson, 1998 [10]; NGSS Lead States, 2013 [13]. The interdisciplinary nature of science education is responsible for particular challenges for carrying out science education research and development. Not only sound competencies in science are necessary but also substantial competencies in various additionl diciplines. In principles the same set of competencies-though with different emphases-has also to be expected from teachers. To know science well is not sufficient for them. At least some basic insight into the nature of science provided by the philosophy and history of science and familiarty with recent views of teaching and learning science provided by pedagogy and psychology are needed [6].

An understanding of the Nature of Science plays an important role in the development of scientific literacy. Besides viewing knowledge about the nature of science as an important for its own value with respect to scientific literacy, an adequate understanding of NOS is expected to improve science content learning by fostering the ability to interrelate scientific content, and thus, coherently acquirescientific content knowledge [5]. A Framework for K-12 Science Education [12] acknowledged the importance of the nature of science in the statement'…there is strong consensus about characteristics of the scientific enterprise that should be understood by an education citizen. The framework reflected on the practices of science and returned to the nature of science in the following statement: "epistemic knowledge is knowledge of the constructs and values that are intrinsic to science. Students need to understand what is meant, for example, by an observation, a hypothesis, and inference, a model, a theory, or a claim and be able to distinguish about them.

The difficulty here is that there is no specific description for appreciation the exact nature of science [7]. In general, the nature of science refers to key principles and ideas which provide a description of science as a way of knowing, as well as characteristics of scientific knowledge [15]. NOS refers to the epistemological underpinnings of the activities of science and the characteristic of resulting knowledge [9]. The phrase "nature of science" typically refers to the epistemology of science, science is a way of knowing, or the values and beliefs inherent to scientific knowledge or the development of scientific knowledge. Beyond these general characterizations, no consensus presently exist among philosophers of science, historians of science, scientists, and science educators on specific definition about NOS. hence, the reason for not placing the word "the" in front of NOS [1].

Although there is not agreement about the definition of nature of science, there are some agreements about the aspect of understanding about NOS. The basic understanding about the nature of science included in the Next Generation Science Standards are:

1) Scientific investigations use a variety of methods
2) Scientific knowledge is based on empirical evidence
3) Scientific knowledge is open to revision in light of new evidence
4) Scientific models, laws, mechanisms, and theories explain natural phenomena
5) Science is a way of knowing
6) Scientific knowledge assumes an order and consistency in natural systems
7) Science is human endeavor
8) Science addresses questions about the natural and material world.

The first of these understandings are closely assocated with practices and the second four with crosscutting concepts.

The basis understanding about nature of science as in [9] are:

1) Scientific knowledge is tentative (subject to change)
2) Scientific knowledge is empirical based (based on and/or derived from observations of the natural world)
3) Scientific knowledge is subjectives (involves personal background, biases, and/or is theory-laden)
4) Scientific knowledge necessarily involves human inference, imagination, and creativity (involves the invention of explanations)
5) Scientific knowledge is social culturally embedded.

Two additional important aspects are the distinction between observations and inferences, and the functions of and relationships between scientific theories and laws.

However, teaching about nature of science sometimes gets lost as it is embedded in regular science instruction. Nature of science in science instruction should be formal and as much as an aspect of subject matter as pH, stages of the life cycles, or the components of the water cycle. That means that we should provide explicit instruction on nature of science [4]. When students carry out an investigation, develop models, articulate questions, or engage in arguments, they should have opportunities to think about what they have done and why. They should be given opportunities to compare their own approaches to those of other students or professionals scientist. Through this kind of reflection they can come to understand the importance of each practice and develop a nuanced appreciation of nature of science [3]. For example, scientists develop their ideas based on evidence and they change their ideas when new evidence becomes available or the old evidence is viewed in a different way. Designing lessons around science topics or concepts that have changed over time can help students understand more about nature of science. Such lessons show students that scientific knowledge in and of itself is not static and that with new information, scientific theories can change. In the lesson, the instruction must be explicit on "how" knowledge has changed and why, e.g. students might get this idea from a lesson or discussion about the solar system and how very recently scientists have just decided that there might be a tenth planet [3].

As we teach these aspects of nature of science, secondary students will be better able to connect what they are doing in their science classrooms to the work of scientists. This explicit approach to teaching nature of science also enables teachers to help students better understand the changing claims that scientists make everyday in television and in the newspapers.

C. Integrating Content and Nature of Science (NOS) in Teaching Materials using MER

There are several reference diciplines that are needed to meet the challenges of investigating and anlysing key issues of teaching and learning science. The Philosophy and history of science provide thinking patterns to critically analyze the Nature of Science (NOS) [9,10]. Besides viewing knowledge about the NOS as an important for its own value with respect to scientific literacy, an adequate understanding of NOS is expected to improve science content learning by fostering the ability to interrelate scientific content and, thus, coherently acquire scientific content knowledge [5].

Initially, the focus of MER was on studies on educational reconstruction of science content. More recently, it became clear that also science processes and view of the nature of science need to undergo this process in order to allow efficient learning and teaching of issues about science [6]. Addressing the need for students to understand both the concepts and practices of science and the nature of science is not new in American education. The MER closely links research on the science content structure and the educational significance of parts of it, and also includes empirical studies on students' understanding as well as preliminary trials of pilot instructional modules in classroom practice.

The Model of Educational Reconstruction (MER) can be used for integrating content and NOS in teaching materials, by the steps of: 1) analysis of scientist's conceptions about specific content and NOS; 2) design and evaluation of learning environment focusing in teaching materials); 3) analysis of students' conceptions about specific content and NOS after using the teaching materials which integrating content and NOS.

III. CONCLUSION

Nature of Science (NOS) is an important material that must be known by all children. Content and NOS can be integrated in teaching materials for improving student's scientific literacy and science content learning. The Model of Educational Reconstruction (MER) can be used for integrating content and NOS in teaching materials, by the steps of: 1) analysis of scientist's conceptions about specific content and NOS; 2) design and evaluation of learning environment (focusing in teaching materials); 3) analysis of students' conceptions about specific content and NOS after using the teaching materials which integrating content and NOS.

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SE– 14

Pedagogical Content Knowledge Case Studies at Junior High School of First Class Science Teacher, in 2013 Curriculum Implementation

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***Abstract*-**This study aims to determine the science learning process in terms of pedagogical content knowledge in the implementation of 2013 curriculum and know the obstacles in implementing a science teacher learning in the Curriculum 2013 **.** This study used a qualitative research case study (qualitative case study) to obtain in-depth information on the implementation of 2013 curriculum. The study was conducted in SMP N 8 Yogyakarta and SMP IT Abu Bakar Yogyakarta . Two schools were selected through purposive sampling technique . Subjects of this study consisted of a science teacher and two students in each school . Instruments that used include science learning process observation sheets, questionnaire for teachers and interview sheets for teacher and students. Data were analyzed using Miles and Huberman analysis techniques which include data reduction , data display and conclusion . The validity of data is done through triangulation of data from observation, interviews and questionnaires. not all aspects of PCK appear in both the curricular knowledge, strategic knowledge, assessment of knowledge and science of nature knowledge .

Keywords: *Pedagogical Content Knowledge, Science Teacher, 2013 Curriculum Implementation.*

I. INTRODUCTION

Implementation of Curriculum 2013 is a step that is sustainable from the previous curriculum Competency-Based Curriculum and Curriculum Education Unit. Completion of the curriculum as a step towards achieving the National Education. Curriculum change carried out as one of the measures to overcome the various problems of the nation's moral quality, the quality of human resources, and the challenges of the development of Science and Technology.

Implementation of Curriculum 2013 demand the ability of teachers in mastering the essential concepts and pedagogical abilities of teachers. 2013 The curriculum emphasizes the attitude domain (spiritual, social), domain knowledge and domain skills. The fourth aspect of this would then be the basis for the preparation of core competencies (KI) and its formulation into Basic Competency (KD). In the 2013 curriculum, learning guides and textbooks have been defined from the center. However, teachers are required to still be able to package the learning-oriented aspects of the attitudes, knowledge and skills. Guidelines for Curriculum Development in 2013 noted that learning science in junior implemented based alignment. Learning science in junior developed as integrative science subjects rather than as educational disciplines. Both as an applicative oriented education, the development of thinking skills, learning ability, curiosity, and the development of caring and responsible attitude towards the natural and social environment. Integrative science has meaning integrating various aspects of domain attitudes, knowledge, and skills. In substance, the IPA can be used as a tool or tools to develop the attitude domain, existing knowledge and skills.

Curriculum implementation in 2013 is something new for teachers, science teacher was no exception. In general, science teachers must have four competencies, namely pedagogy competency, professional, personal and social. Specific competencies Science teacher also stated in NSTA (2003: 1) which recommended Standards for Science Teacher Preparation [1]. This standard contains a number of standards that must be owned by a science teacher standard includes content, nature of science, inquiry, Issues, general skill of teaching, curriculum, science in the community, assessment, safety and welfare, professional growth. This standard is consistent with the vision of NSES (National Science Education Standards). NSTA (2003: 8) in Insih Wilujeng (2010: 353), also recommended that the science teachers of Primary and Secondary schools should have the capability of interdisciplinary science [9]. This is the underlying need for a science teacher to have competence in teaching in an integrated IPA (integrated), including integration in the field of science, integration with other fields such as technology, health and integration with penacapain attitude, scientific processes and skills.

In carrying out the science lesson on the curriculum in 2013, required capabilities related to the content (content) materials science and how membelajarkan IPA. This approach is known as approach PCK (Pedagogycal Content Knowledge). [2] Shulman (1986) in S.K Abell, D. L. Hanuscin, M. H. Lee, M. J Gagnon, (2008) provides a basis to think that to teach science is not enough to simply understand content Material Science (knowing science) but also how to teach (how to teach). Science teachers must have knowledge of science learners, curriculum, instructional strategies, assessment so that it can carry out the transformation of science knowledge.

The emergence of the curriculum in 2013, requires an adjustment of teachers in accordance with the teaching pack teruang in Curriculum 2013. It is also a reference LPTK in preparing prospective science teachers to be competent in accordance with that stated in 2013. Curriculum science teacher preparation program at the level LPTK need data analysis of the needs of the field. The needs analysis capabilities include pedagogy, content capabilities materials needed in the implementation of Curriculum 2013 and obstacles in implementing a science teacher learning science in the curriculum of 2013. It aims to do a case study to reveal the ability of science teachers in implementing the curriculum learning science in 2013. Broadly speaking, this study has a position that is essential for further research both on the subject of teachers in the field and the preparation of prospective teachers in LPTK environment. The objective of this study was to determine the science learning process in terms of pedagogical content knowledge in the curriculum implementation in 2013, knowing the science teacher obstacles in implementing the learning according to the curriculum in 2013.

II. LITERATURE VIEW

A. Curriculum 2013

Curriculum development in Indonesia occurred from 1947, 1964, 1968, 1973, 1975, 1984, 1994, 1997, 2004, 2006 and until 2013. Curriculum curriculum sustainable development based a variety of factors. This is corroborated by the opinion Oliva (1992: 29) [3], "The curriculum is a produc of its time, curriculum responds to and is changed by social forces, philosophical positions, psychological principles, accumulating knowledge, and educational leadership at its moments in history". Of that argument, it can be summarized that the development of the curriculum meet the challenges that changes in social, philosophical aspects, science and technology development.

Guidelines for Curriculum Development in 2013 noted that learning science in junior implemented based alignment. Learning science in junior developed as integrative science subjects rather than as educational disciplines. Both as an applicative oriented education, the development of thinking skills, learning ability, curiosity, and the development of caring and responsible attitude towards the natural and social environment. Integrative science has meaning integrating various aspects of domain attitudes, knowledge, and skills. This is consistent with the understanding of science is integrated by Hewitt, Paul G and etc (2007: xvi), that integrates science presents aspects of physics, chemistry, biology, earth science, astronomy and other aspects of Natural Sciences [4]. In his book Conceptual Integrated Science, Integrated IPA is presented based contextual approach is to connect science to everyday life, personal and direct, put one of the main ideas, contains troubleshooting. In the presentation, IPA presented with unity concept to develop the realm of knowledge, attitudes and skills.

B. PCK (Pedagogycal Content Knowledge)

Shulman (1986) in S.K Abell, D. L. Hanuscin, M. H. Lee, M. J Gagnon, (2008: 79) gives the concept of thinking about the PCK as follows:

"... .knowing Science is a Necessary but not sufficient condition for teaching. Science teacher Also must have knowledge about science learner, curriculum, instructional strategies, and assessment through the which they transform Reviews their knowledge in science to effective teaching and learning ". [11]

The concept of thinking gives the sense that the PCK for teaching science is not enough just to understand the science of matter content (knowing science) but also how to teach (how to teach). Science teachers must have knowledge of science learners, curriculum, instructional strategies, assessment so that it can carry out the transformation of science knowledge. Shulman (1986: 9), defines the content knowledge into three categories of subject matter content knowledge, pedagogical content knowledge, curricular knowledge.

C. Learning Science

Koballa and Chiappetta (2010: 105), defines science as a way of thinking, a way of Investigating, a body of knowledge, and interactions with technology and society [5]. IPA can be summarized that there is a dimension in the way of thinking, a way of investigation, building science and its relation to technology and society. This becomes the substance of the fundamental importance of learning science who developed the scientific process for the formation of the mindset of learners. According to Sund & Trowbridge (1973: 2), the word science as "both a body of knowledge and a process" [6]. According Trefil, James and Robert Hazen (2007: xii), integrated approach (An integrated approach) involves a scientific process, organizing principle, organizing the natural integration of scientific knowledge and its application in everyday life [7]. In addition, in an integrated approach is also expected to be able to link students in other fields include physics, astronomy, chemistry, geology, biology, technology, environmental, health and safety.

III. RESEARCH METHODS

This study used a qualitative research with case studies (qualitative case study) to obtain in-depth information on the implementation of Curriculum 2013.

Case study research is a qualitative approach in the which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in depth of data collection, involving multiple sources of information (eg, observation, interviews, audiovisual materials, and documents and reports) and reports a case description and case-based themes. (Creswell, 1998: 73) [8]. Schools that used in this study will be determined through purposive sampling on the basis of the junior high school in the city of Yogyakarta that SMP N 8 Yogyakarta and junior IT Abu Bakar Yogyakarta. This research subject is a science teacher and second grade VII students of class VII in SMP N 8 Yogyakarta and junior IT Abu Bakar Yogyakarta.

Data collection techniques used in this study include observational techniques non partisipants, documentation, and semi-structured interview. Observation techniques used to see the implementation of science teaching in class VII implementing Curriculum 2013. Interview techniques used to obtain information readiness, barriers to learning science teachers in implementing the curriculum in accordance 2013. Instruments and grating instrument contained in the annex.
The qualitative data obtained from observation, interviews and documentation were then analyzed using qualitative analysis techniques Miles and Huberman, namely data reduction, data display and conclusion. [10]

IV. RESULT AND DISCUSSION

A. *Curricular knowledge*

TABLE 1. DESCRIPTION OF CURRICULAR KNOWLEDGE

Indicator	**Result of research**	
	SMP IT Abu Bakar Yogyakarta	**SMP 8 Yogyakarta**
Planning a scientific approach based science learning (observation, questioning, reasoning, experimental)	Teachers formulate their own lesson plans through discussion forums science teachers in one school. - Each teacher makes RPP then shares and discuss with friends the other science teachers.	Some already planned scientific but some have not. -Teacher uses a collection of lesson plans when socialization training curriculum in 2013
Formulating objectives and indicators of learning	Learning objectives statement in RPP includes the processes and results - Formulation of learning objectives contain a affective, knowledge, skills aspects - Indicator of knowledge aspect was formulated in C1-C3	- Formulation of learning objectives already includes the processes and result - Formulation of learning objectives contain a affective , knowledge, skills aspects. - Indicator knowledge was formulated C1-C3.
Develop techniques and instruments are thoroughly	instruments in the RPP include scientific behavioral observation sheet instruments, observation skills sheet and essay questions.	teachers use the ready-made lesson plans from the curriculum 2013 training. - Instrument in the RPP include attitude observation sheets, sheets observation skills, essay test questions.
learning in the lesson plan that integrates KI I, II, III, IV.	-In the RPP are KI I, II, III, IV - Indicators are formulated into the attitudes, knowledge, skills	teachers use the ready-made lesson plans result of socialization curriculum in 2013 - In the RPP were referred to, there are KI 1, II, III, IV.

B. *Knowledge of instructional strategies*

TABLE 2. DESCRIPTION OF KNOWLEDGE IN INSTRUCTIONAL STRATEGIES

Indicator	SMP IT Abu Bakar Yogyakarta	SMP N 8 Yogyakarta
The learning process is to develop creativity - Generating idea: generating ideas in the discussion - Relating: able to make a connection to a specific situation - Inference - Predicting - Make generalization - Visualization - Synthezing - Hypothesis - Making analogies - Inventing	When the material is standard unit of measurement, students are asked to specify the type of the measuring instrument, which uses no shoes, inch, ruler, eraser, fathoms- Based on the observation, students confusion when working on a discussion question after taking measurements to make generalizations. The question is "based on the comparison, the important thing is to be formulated"	Students make origami (paper form colored) to show the classification dichotomy
Scientific learning activities (observing, questioning, reasoning, experimental)	Students take measurements of classrooms, desks and other objects using the span, fathoms, ruler. When making measurements, the students ask questions related to who they do not know. Teachers are not directly answer but give petanyaan to lead students to answer questions.	Students are invited to observe the torso When the material of cells, tissues, organs, students make fresh preparations of plant rhoediscolor and membranes in the onions then observed under a microscope.
Guiding students to find out, will not be notified of (discovery learning) includes the stimulation, discussion tasks and problem identification, observation, data collection, data processing and analysis, verification, generalization)	Based on the observation of the process, teachers lead students to find out through the investigation .When the student asked, the teacher directed by asking questions again At the beginning before the investigation, the teacher showed pictures of various gauges, outlines the objectives and provides worksheets . In the beginning was not emphasized students are invited to identify the problem.generalization	Based on observations, the teacher comes in, the teacher gave the introductory material of cells, tissue organs and then the students observe the cells by making fresh preparations and preparations preserved. Teachers do not make and give worksheet again. Students carry out surveillance activities using students' books. At the beginning, the students have not been invited to identify the problem and the teacher did not give the problem first.
Applying the learning model of problem-based learning, project based learning and discovery-inquiry-based learning and other approaches constructivism	Based on the observation, identify the problem does not arise, and the students have not been able to do lesson plans and processes. Lesson plan compiled using the model of discovery learning Teachers have not tried using project based learning and problem based learning.	Based on the observation of the process, which appears observation. Based on observation, the students are not being led to relate the observed data of cell for was generalized
Learning science is done with coherence (integrated science)	Based on the observation process, associate professor with the material aspects of the attitude, for example, when asking the lamp inventor Thomas Edison, the teachers stressed that the IPA invention involves various religions. This leads to tolerance and respect. When measuring the material, students are asked to look at pictures of leaves on paper mm. students are asked to calculate its area. Students are not asked to measure directly the leaves. To motivate and reduce boredom during activities, teachers often play the short video example of a disabled child that persistent struggle and songs of encouragement more. When the teacher asked reviewing IPA object, after students answer the teacher gives confirmation that God's grace provides an opportunity to look at objects	It does not appear either its integration with aspects of the attitude or in the content material.

	and microscopic living creatures. When the teacher asks the distance between the sun and the earth with SA, teacher linking with the distance of the field maksar, "then we should do?"	
Integrating between concepts within major theme carried out with the model connected, webbed	The material of measurement associated with the measurement of leaf It uses a connected model.	Not seen its integration
Awarded the project to solve authentic problems (related to everyday life related science objects)	Given projects unit of measurement of the standard unit and not standard unit.	project-based learning yet

C. *Knowledge of understanding of science*

TABLE 5. RESULT OF KNOWLEDGE IN UNDERSTANDING SCIENCE

Indicator	SMP IT Abu Bakar Yogyakarta	SMP N 8 Yogyakarta
Mastering the science concepts being taught and follow the development of science.	Based on the observation, when the material differences in monocots and dicots, student confusion when discussing types whose roots are in the worksheeet. The content of science, associated with the inventor of the light and the inventor flasdisk.	When observation, observation material of cells, tissues, organs. Teachers do not associate with the issue of development of the science.
Content of science was presented integrated not separated in groups of physics, chemistry, biology	Based on observation, teacher associate the measurement with the size of bacteria. Linking measurement to measure the leaf area.	There was no integration
Materials and activities are enriched with the needs of students to think critically and analytically	In worksheet, yet bring all aspects of critical thinking. It can be seen from the discussion questions after the data collection.	There was no appears during learning.

D. *Knowledge of assesment.*

TABLE 4. RESULT OF KOWLEDGE IN ASSESMENT

Indicator	**SMP IT Abu Bakar Yogyakarta**	**SMP N 8 Yogyakarta**
Measuring behavior (KD of KI and KI II), knowledge (KD at KI III) and skills (KD at KI IV)	In the RPP, the teacher has drawn up an assessment rubric of attitudes, and cognitive skills. When learning, teachers are overwhelmed in assessing various aspects and have not memorized the names of students	The teacher asks the students to collect the product in the form of images of cells observed students. Teachers around watching each group but did not use the assessment sheet Students when the interviewee feels judged for teachers around
Measuring KD at KI I and KI II and II through behavioral observation, measuring KD at KI III through a written test, measure at KI KD IV with the product assessment, performance, project and portfolio.	Based on the observation of the process, teachers around watching each group Do not look the teacher brought sheets to assess the behavior Based on the interviews, teachers find it difficult to assess many aspects and have not memorized the names of their children. Students did not do the activities when the teacher not observed the group Written test is done with a quiz about converting the size of bacteria	Teachers are not visible to assess the behavior and attitudes. Based on the interviews, the teacher has not memorized the names of the students. Teachers are overwhelmed with many kind of assesment rubric.
Measuring the level of thinking of students ranging from low to high	Based on observations of the mid test, the shape of the essay test develop the ability to observe symptoms, determine the amount using a measuring instrument (balance two arms, stopwatch, ruler), the ability of prediction.	Teachers are not visible to assess their attitudes and behavior. Based on the interviews, the teacher has not memorized the names of the students. Teachers are overwhelmed with the number of rubrics.
Stressing on questions requiring deep thought C3-C6 (critical thinking):	When the learning process, after all the groups to write the data, the teacher leads to the question:	Based on observations, the teacher is less led to the students find their own answers.
Measuring student work process, not just the student's concept.	Teachers arounded give attention working each group of students. But the teacher did not bring paper assessment rubric.	Teachers around, but did not bring the assessment sheet. Based on the interviews, teachers difficulty judging process because of the

	Based on interviews, the teacher is judging process when students do activities but the weakness of the teacher is not able to learn the names of all students.	large rubric, has not memorized the name of students and the time is short.
Using a portfolio of student learning	Do not appear	Students write down the results of the images of cells and tissues in a special task book, and then a teacher check the result.

Based on the formulation of the problem, this study aims to determine the learning process on the implementation of the curriculum in 2013 and knowing the obstacles of learning science curriculum mlealui 2013. Data collection was conducted classroom observations, interviews, questionnaires, and observation of RPP and LKS. Classroom observations conducted in each school four times. Presentation of data in the learning process in terms of (1) curricular knowledge; (2) knowledge of instructional Strategics for teaching science; (3) knowing of understanding of science and science teaching; (4) knowledge of assessment. Complete data research results are presented in the appendix. The following are the results of the data reduction process of learning in the curriculum implementation in 2013. Curriculum 2013 first piloted in 2013. In Yogyakarta there are 29 junior high schools as a pilot curriculum implementation, 2013. In a research school that is used as an object of research is a junior IT Abu Bakar Yogyakarta and SMPN 8 Yogyakarta. Research focuses on knowing the process of learning science and science teacher obstacles in the implementation of the curriculum in 2013. Review of aspects of curricular knowledge, the process of learning science in 2013 has been planned curriculum-based scientific. In planning the study, there is a science teacher who uses the result of socialization training curriculum lesson plan 2013. In addition, there is also a science teacher who developed more tailored to schools and learners. Based on the judgment of the lesson plan, the formulation of objectives already contain processes and products that will be achieved. Assessment instrument that was used includes, attitudes, cognitive and skills. Indicators are formulated C1 until C3. Viewed from the aspect of knowledge of instructional strategics, the teachers have been working to develop creativity. Creativity indicator that not yet was developed consists of ; make generalization, relating, inventing, making analogy, hypothesis, synthesis, generating ideas. Creativity aspects that arise include visualization, inference and predicting. Lesson activities already based scientific. Students are directed to do observation and measure. However, students have difficulties to make reasoning to the formulation of the conclusion . Questioning ability of children have emerged but have not describe the level of critical thinking. The type of questioning that emerged in the C1 until C3 level. To develop the children ability must be stimulated by the teacher by first asking questions. The question was brought from issues that make curiosity of students. Lesson activities has led students to seek out (discovery learning). Based on observation, problem identification phase has not been raised and the students have not been able to generalize. Teachers do in the beginning is to provide introductory material is not a problem to be solved. Presentation function in stimulating learning problems. This stage is important in the early stages of the discovery learning. Lesson plan compiled using the model of discovery learning. Teachers have not vary with the model of problem based learning, project based learning and other contructivistiC approach. In its application in the classroom, the model has not been all phases of discovery learning is raised. A phase which has not been raised is the stage invites students to identify problems. The integration of the science content has been raised but still constrained by a factor of mastery of knowledge in accordance with the scientific background of teachers. With reference to the book of teachers and students, the teacher should be able to bring its integration. The integration can be seen from the integration of science and attitudes, and the integration of materials science (physics, chemistry, biology, earth space). One teacher has been integrated with the realm of attitudes (religious and social). However, teachers in other schools may not be able to create a better alignment with the realm of attitudes, knowledge, skills and integration of own material. In this case requires the ability of teachers to develop the material and enrich the material to be able to integrate. Based on the observation of student books, teacher books and learning process in the classroom, integrating model use of science concept using a connected model. In lessons, teachers are giving the project examples; observing microorganisms in various water samples. Teachers need to have the ability to relate the concept with the development of science. Science teacher at SMP Abu Bakar follow the development of science by linking the inventor of the light, the inventor flasdisk. In SMP N 8 Yogyakarta, has not been associated with the development of science and technology. In the aspect of integration, a teacher in Abu Bakar link the material of measuring the size of bacteria and leaf area. In SMP N 8 Yogyakarta, has not raised its integration. The ability to package and develop materials to other areas needed to be able to present a unified science of matter. Teachers need to continuously enrich the sources of information related to concepts or materials in order to overcome obstacles scientific background factor. Review of critical thinking aspects, science teacher at SMP Abu Bakar not bring all the components of critical thinking. It is seen in worksheet, where the questions were designed in the level of C1 until C3. While science teacher at SMP N 8 Yogyakarta, has not led to all aspects of critical thinking. In the aspect of assessment, teachers difficulties in assessing the attitude and the process because there was many rubrics. For cognitive assessment, teachers are able to perform well through quizzes, midterms and final exams. Product assessment has been done by teachers.

CONCLUSION

In this case study, there are some important things that related with to the curriculum 2013 implementation (a). Difficulty getting students to reason(b). Difficulty assessing authentic(c). Difficulties in step to direct scientific reasoning(d). Students having trouble reading the observed data to be formulated into a conclusion(e). Fears of teachers with national test pattern given product-oriented mindset and learn science activities with scientific emphasis on the process.(f). The limited ability of teachers in combining materials science (chemistry, physics, biology) because of factors mastery of teachers who are not relevant to the scientific background.(g). Limitations children get information from sources other book when the book more students invites students to observe, think, analyze the (scientific).(h). The difficulty in assessing the attitudes and processes with many rubric (i). Difficulty developing the creative aspect(j). Difficulties in developing critical thinking.

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